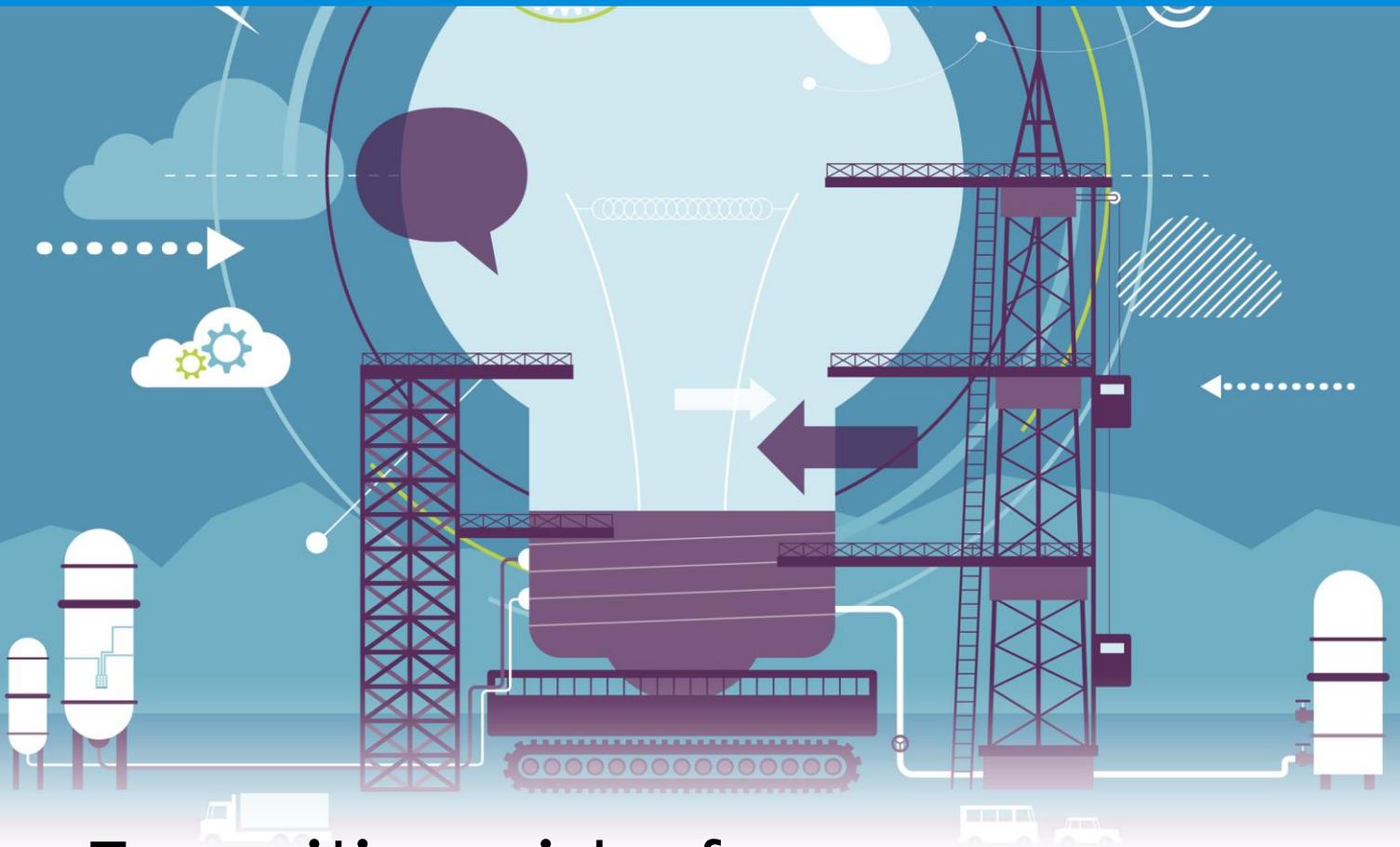


Climate scenario compass

Climate Change & Natural Capital



31 January 2018



Transition risks for electric utilities

Summary

Since the FSB Task Force on Climate-related Financial Disclosures (FSB TCFD) published its recommendations, there has been a greater emphasis on scenario analysis to assess the opportunities and risks from measures taken to limit global warming. Building on our Investor primer to transition risk analysis, this report has two climate scenarios for the utilities sector, and specifically for Engie, ENEL, and EDF. We show the implications for these companies' valuations under two illustrative strategic choices. We provide insights for company engagement and financial performance with their regional and technology contributors as well as sensitivities.

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Energy Transition Risk Project

Project details at the end of the report and under www.et-risk.eu



Please refer to the last page of this report for "Important disclosures"

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 696004. The text reflects only the author's view. The Agency (EASME) under the power delegated by the European Commission is not responsible for any use that may be made of the information it contains.

If you only have one minute

Key conclusions

Climate scenario analysis for utilities

This report is the second of a series of five, as part the Energy Transition Risks project that investigates the financial impact of climate-related transition scenarios on companies. Drawing on the first study *Investor primer to transition risk analysis*, which examines the methodological challenges and introduces our framework, this report contains a transition risk scenario analysis for the utilities sector, focusing on EDF's, Engie's, and ENEL's electricity generation.

Macro climate scenarios and company trajectories

We use The CO-Firm's climateXcellence model to assess two climate scenarios and two ways companies can adapt:

- **Macro scenario:** Two scenarios from the latest (2017) IEA Energy Technology Perspectives (ETP) are used to assess company-level risks: 1) the **Limited Climate Transition** scenario (LCT), which refers to the "Reference Technology Scenario" (c. 2.7° C); and 2) the **Ambitious Climate Transition** scenario (ACT), which corresponds to the "2°C Scenario" (c. 2° C temperature increase by 2100).
- **Company adaptations:** Companies can pursue two adaptive paths: 1) "**Market**" expects companies to invest relative to their current market share by country and technology along the sector and country changes in scenario technology portfolios, and; and 2) "**Market EBIT**" acknowledges that financially strong companies (higher EBIT) can capture a larger share of profitable growth.
- **Financial KPIs:** Results include the relative developments of EBITDA, EBIT, depreciation, and EBITDA sensitivity.

Key findings: tools for engagement and further research

Kepler Cheuvreux looks at how to include these results in valuations. While our findings suggest that these companies may benefit under the ACT scenario, we caution that this should not be seen as an investment recommendation or forecast, instead they are one of many plausible transition scenarios. Our conclusions are intended first and foremost to provide tentative tools and insights to fuel investor engagement and initiatives to improve company disclosure and refine scenario analysis methods.

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The Energy Transition Risk Project

The ET Risk consortium, funded by the European Commission, is working to develop the key analytical building blocks needed for Energy Transition risk assessment and bring them to market.

1. **Transition scenarios:** The consortium will develop and publicly release two transition risk scenarios, the first representing a limited transition extending current and planned policies and technological trends (e.g. IEA ETP RTS trajectory), and the second representing an ambitious scenario that expands on the data from the IEA ETP 2DS.
2. **Company data:** Oxford Smith School and 2° Investing Initiative will jointly consolidate and analyse asset level information across six energy-relevant sectors (power, automotive, steel, cement, aircraft, shipping), including an assessment of committed emissions and the ability to potentially “unlock” such emissions (e.g. reducing load factors).
3. **Valuation and risk models:**
 - a. The climateXcellence Model – The CO-Firm's scenario risk model covers physical assets and products and determines asset-, company-, country-, and sector-level climate transition risks and opportunities under a variety of climate scenarios. Effects on EBITDA, EBIT, depreciation, capital expenditure and discounted cash flows are illustrated under different adaptive capacity assumptions.
 - b. Valuation models – Kepler Cheuvreux. The above impact on climate- and energy-related changes to company margins, cash flows, and capex can be used to feed discounted cash flow and other valuation models for financial analysts. Kepler Cheuvreux will pilot this application as part of its equity research.
 - c. Credit risk rating models – S&P Global. The results of the project will be used by S&P Global to determine if there is a material impact on a company's creditworthiness.
 - d. Assumptions on required sector-level technology portfolio changes are aligned with the Sustainable Energy Investment (SEI) Metrics ([link](#)), which developed a technology exposure-based climate performance framework and associated investment products that measure the financial portfolio alignment.

Acknowledgements

For sharing his insights, and providing feedback in the writing of this report, we wish to thank Mark Fulton.

Mark is an advisor to the Carbon Tracker Initiative and the 2° Investing Initiative; a Senior Fellow at CERES; and Special Advisor to the Climate Bond Initiative.



See seimetrics.org for more information on the “sister” project on companies' technological exposure

Objectives and readers' guide

This report aims to illustrate how scenario-based financial risk analysis can be performed in the utilities sector and if and how it can be relevant to company analysis and, specifically, valuation.

This is the second in a series of five reports. The first report, *Investor primer to transition risk analysis*, discusses the methodological and conceptual underpinnings of such an endeavour. This report tests the previously developed methods on the utilities sector, and more specifically on EDF, Engie, and ENEL. Upcoming reports will apply these tools to additional sectors.

The primary audience of this report is financial analysts that wish to understand the more technical aspects involved in scenario analysis, and the materiality of the impact of scenario parameters on company performance, including valuation. This report is meant to contribute to the ongoing conversation about these themes.

The CO-Firm lays out methodologies to determine financial risk based on climate scenarios. Kepler Cheuvreux then investigates how to integrate these results within traditional valuation models. The results should not be considered investment recommendations, financial forecasts or judgement of their veracity, but rather illustrations of one of many plausible energy transition scenarios. It constitutes an outside-in analysis for providing company engagement guidance, on strategic and financial resilience.

None of the comments or data included in this report should be seen as informing about or relating to Kepler Cheuvreux's equity analysts' ratings or views on any company mentioned in this report (primarily, ENEL, as Kepler Cheuvreux's coverage of both EDF and Engie is currently suspended).

Table 1: What can you find in this report?

Chapter	Description
Results at glance	Lays out the two climate transition scenarios and the two strategic choices/adaptive pathways for companies' portfolio development that are the building blocks for this scenario analysis. Shows the key results of the company-specific impact on discounted cash flows, EBITDA, as well as providing an EBITDA heatmap for country and technology combinations and EBITDA sensitivity.
Electric utilities in climate transition	Describes and gives examples of the changing energy landscape for electric utilities and the associated financial impact. Outlines The CO-Firm's two climate transition scenarios and two adaptive capacities in greater detail. Scenario analysis complements alignment assessments.
Scenario-based financial risk analysis: Results	Presents the risk analysis results in six steps. <ul style="list-style-type: none"> The first step outlines the impact on financial KPIs (i.e., EBITDA, EBIT and depreciation) for ENEL, Engie, EDF and the global utilities sector under our two climate transition scenarios. The second to fifth steps show global utility and company-specific deep-dives into the financial impacts, technological portfolio development and the robustness of earnings with the help of company/technology-specific sensitivity analyses. The sixth and last step looks at companies' financial performance with the help of country/technology-specific EBITDA heatmaps and discusses the underlying rationale.
Embedding the results in valuations	Can the results of transition risk modelling be used in bottom-up stock valuation, and if so, how? What are the further areas for investigation?
Appendix: ClimateXcellence model	Gives an overview of The CO-Firm's climateXcellence model, the methods applied and their limitations. See also <i>Investor primer to transition risk analysis</i> published by Kepler Cheuvreux and The CO-Firm (link) that provides a more detailed discussion of the concepts and analysis steps described below

Source: The CO-Firm and Kepler Cheuvreux

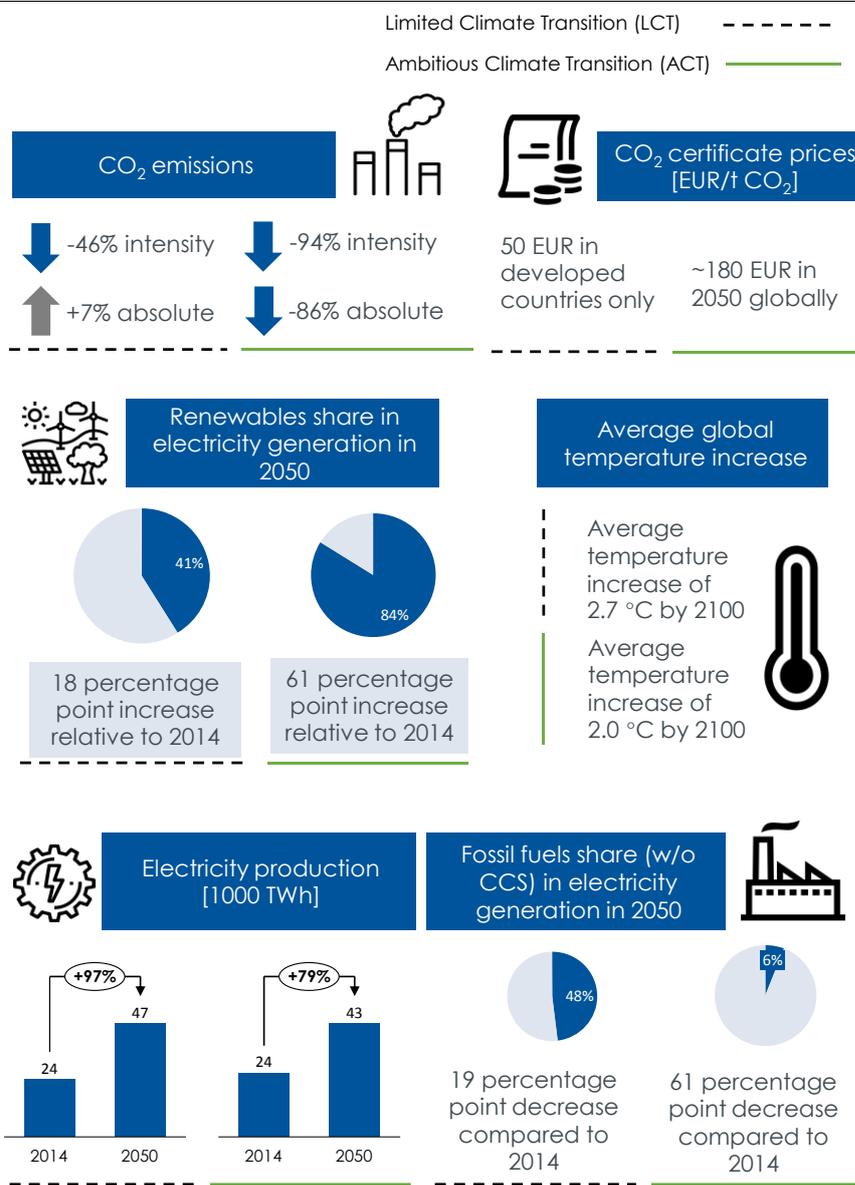
Underlying scenarios, adaptive options, and results at a glance

Building blocks: transition and adaptation scenarios

The building blocks of the analysis are two climate transition scenarios, and two adaptive pathways. The scenarios, namely the Ambitious Climate Transition (ACT), corresponding to IEA Energy Technology Perspectives' 2°C scenario, and the Limited Climate Transition (LCT), corresponding to the IEA's Reference Technology Perspective (RTS), with a 2.7° C global warming limit by 2100. The two scenarios, i.e. ACT and LCT, complement the IEA's scenario with a consistent narrative on regulatory, technology and market-related changes (Chart 1; for further information see page 17).

The building blocks of the analysis are two climate transition scenarios and two adaptation scenarios

Chart 1: This report tests for the financial impact of two transition scenarios

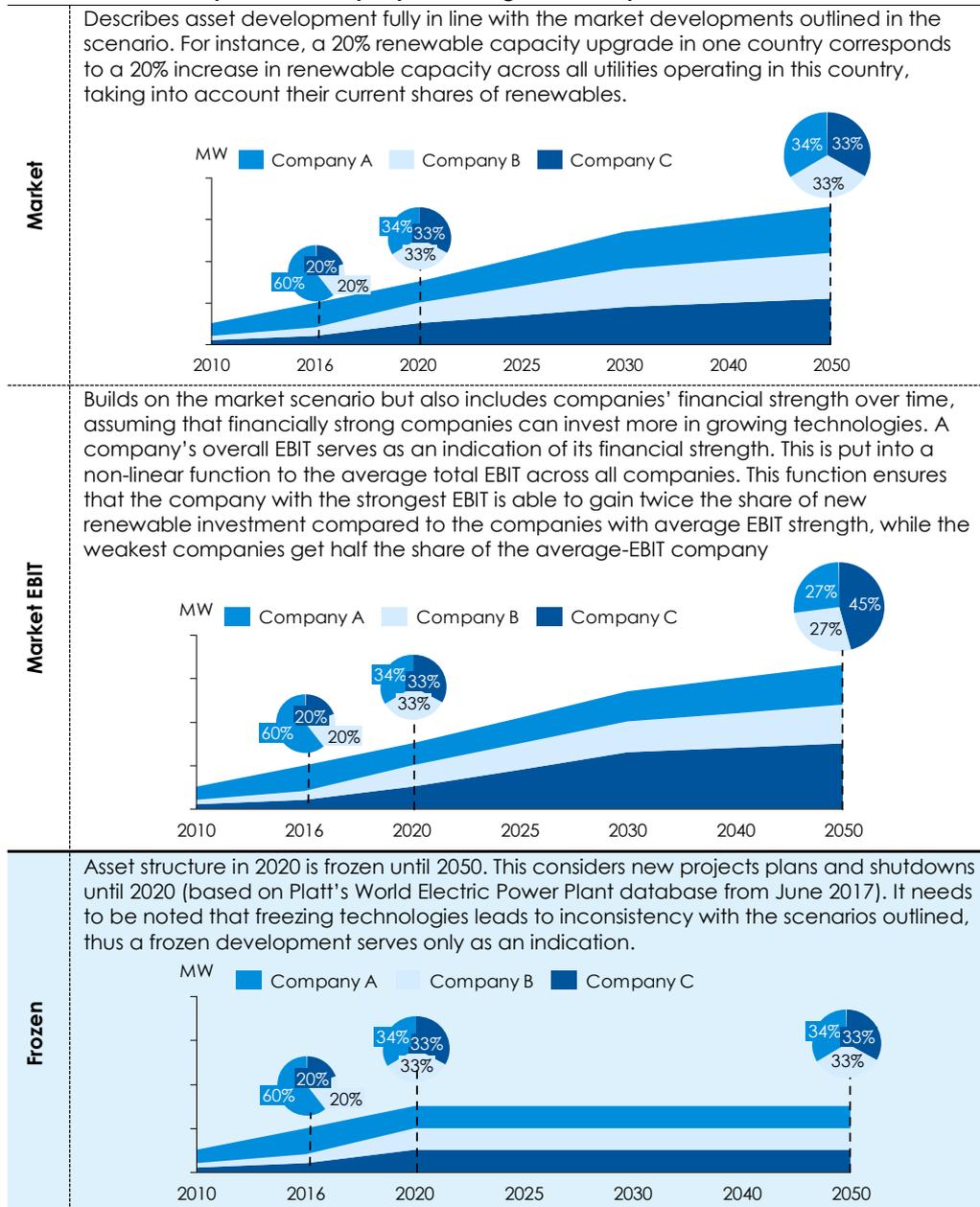


Source: The CO-Firm

Paramount to financial performance is the utilities companies' physical asset park. The CO-Firm distinguishes two ways to adapt, or "strategic approaches", in which companies make changes to the capacity levels. These are called "Market", a portfolio development in line with the scenario requirements, and relative to current exposure, and "Market EBIT", which acknowledges that financially stronger companies (higher EBIT) have greater potential to capture a larger share of growth (Chart 2; for further information see page 17). For illustrative purposes, a "Frozen" portfolio is illustrated in which the impact on a stable company portfolio from 2020 onwards is shown. It is important to note that "Frozen" is neither a company strategy nor consistent with the outlined scenarios.

Key to financial performance is companies' physical asset park

Chart 2: Three assumptions on company technological development



Source: The CO-Firm

Key results: Engie

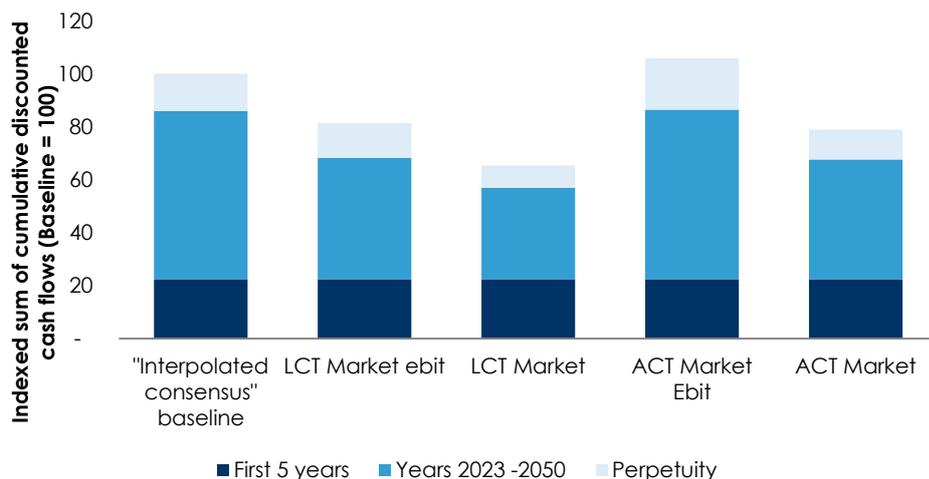
- **Highlight 1:** Engie's cash flows are 6% higher in our Ambitious Climate Transition (ACT) scenario than the Bloomberg "interpolated consensus", i.e., the baseline used here.
- **Highlight 2:** Engie has the potential to leverage its financial position to benefit more than average from potential growth.
- **Highlight 3:** Renewable investments in favourable markets such as Brazil, Mexico and the US are paramount.
- **Highlight 4:** Over time, Engie's EBITDA sensitivity to changes decreases.



[CSR reporting \(link\)](#)

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

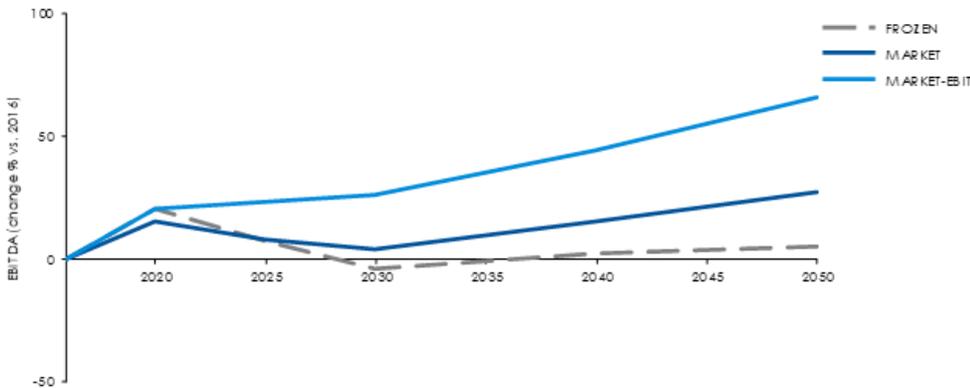
Chart 3: While Engie would benefit from a 2°C-compatible Ambitious Climate Scenario (ACT) compared to the Limited Climate Transition (LCT) scenario, it appears to be overvalued in three of the four scenario/adaptive pathway combinations.



Under The CO-Firm's ACT scenario, and Market Ebit adaptation, Engie's cash flows would be higher compared to "interpolated consensus" (Bloomberg)

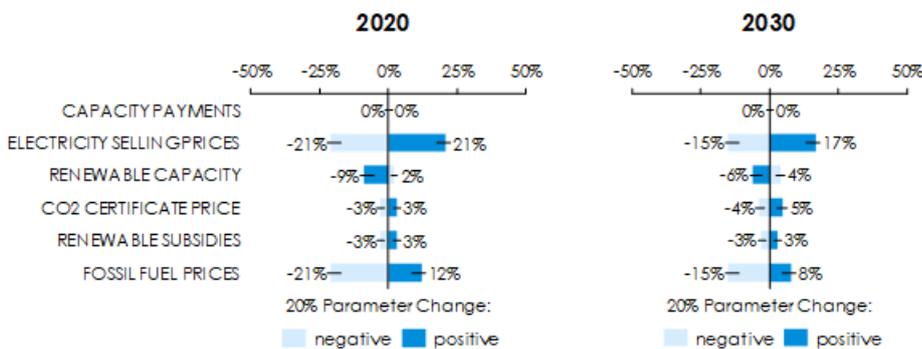
Source: Kepler Cheuvreux; "Interpolated Consensus" baseline represents current valuations, per Bloomberg valuation Excel tools and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other data based on The CO-Firm's ClimateXcellence model.

Chart 4: Zooming in, having technologies in gas, water, and renewables across the globe, Engie is able to increase EBITDA through new renewable investments and profit from market growth (ACT/Market EBIT scenario).



Source: The CO-Firm

Chart 5: Zooming in, globally, Engie's EBITDA is particularly sensitive to volatile market situations as well as potential changes in fossil fuel prices (i.e., natural gas and coal)



Source: The CO-Firm

Engie can see highest increase of EBITDA under Market-Ebit adaptation in the ACT scenario

Changing spot prices and falling fuel prices will have a comparatively high impact on Engie's EBITDA

Engagement questions:

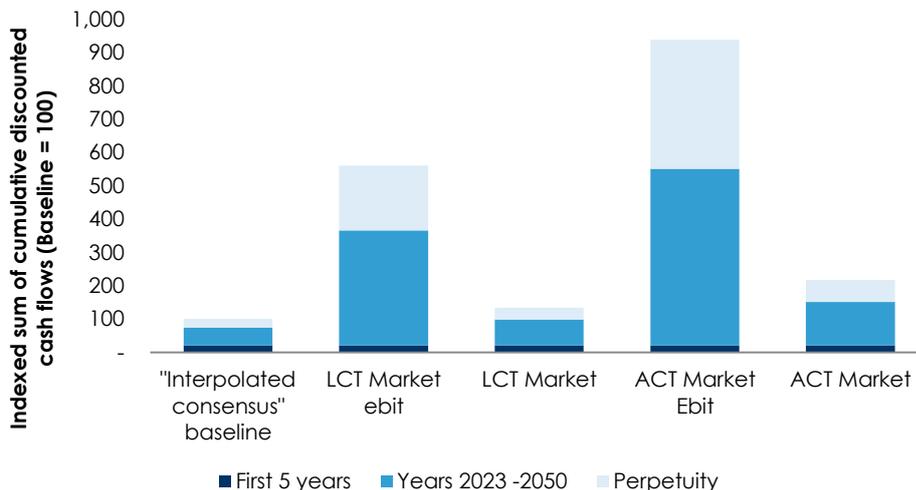
- **First chart:** Are you planning to report a quantitative scenario analysis, for example, based on the key strategic sector transformation risks you identified in your 2017 integrated report?
- **Second and third charts:** What build-out plans do you have and in what markets?
- **Fourth chart:** How do you manage downside risks, especially from changes in fossil fuel and electricity selling prices?

Key results: ENEL

- **Highlight 1:** Under The CO-Firm's ACT scenario, ENEL's cash flows would be much higher than what is already forecast by Bloomberg's "interpolated consensus".
- **Highlight 2:** ENEL's financial position can allow it to benefit from global growth and the climate transition.
- **Highlight 3:** ENEL is already well positioned in high-growth markets.
- **Highlight 4:** With adaptation, EBITDA sensitivity decreases.

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development, Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

Chart 6: ENEL would benefit from both transition scenarios, especially under the "Market EBIT" adaptation scenario; it appears to be undervalued in all scenario/adaptive pathway combinations



Source: Kepler Cheuvreux; "Interpolated Consensus" baseline represents current valuations, per Bloomberg valuation Excel tools and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other data based on The CO-Firm ClimateXcellence model

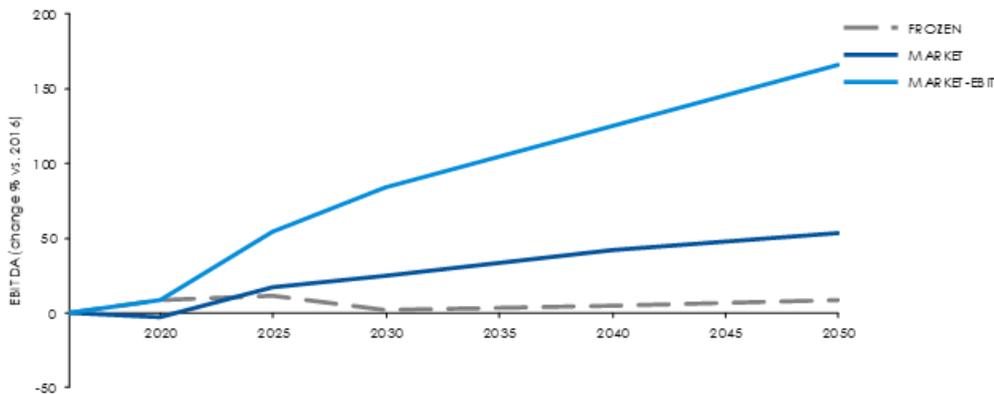


[Approach to scenario analysis \(link\)](#)

[2016 Sustainability report \(link\)](#)

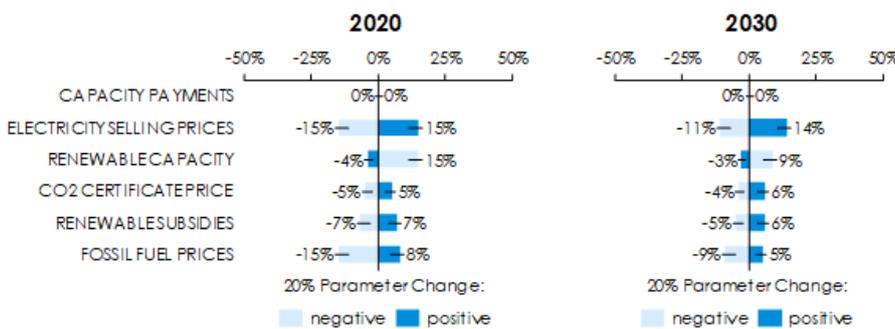
ENEL appears to be the "unpriced" winner under each scenario, especially The CO-Firm's ACT (2°C) scenario

Chart 7: Zooming in, having the financial strength and being invested in water, wind, and solar in growing markets today, ENEL has the adaptive capacity for a large-scale transformation of its technology structure over the next 30 years.



Source: The CO-Firm

Chart 8: Zooming in, ENEL is comparatively sensitive to increasing shares of renewables in the electricity systems partly due to its high share of gas technologies



Source: The CO-Firm

For ENEL, the transformation can pay off well in the ACT scenario with a greater EBITDA increase

As ENEL's portfolio grows and diversifies over time, external shocks will have less impact on the EBITDA

Engagement questions:

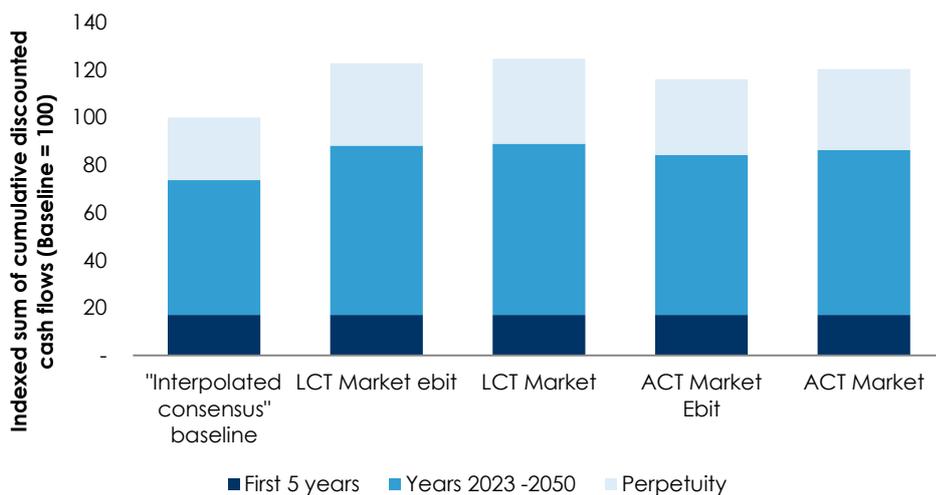
- **First chart:** Are you planning to disclose key parameters, sensitivities and results of the business plan and portfolio test across a range of scenarios? When using scenario analysis to support the industrial plan and strategic target definition, what type of strategy do you adopt (e.g. minimal regret or more aggressive maximisation)?
- **Second and third charts:** What are your divestment or investment plans, especially in terms of coal and gas in Italy?
- **Fourth chart:** How will you mitigate fossil fuel price risks?

Key results: EDF

- **Highlight 1:** EDF's cumulative discounted cash flows are very close in both scenarios, but c. 20% higher than Bloomberg's "interpolated consensus".
- **Highlight 2:** EDF could participate in global EBITDA growth and can create additional upside.
- **Highlight 3:** EDF's current technology and geographic footprint allow it to participate in growth markets.
- **Highlight 4:** Proactive portfolio reconfiguration can enable EDF to decrease its EBITDA sensitivity to external changes.

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development, Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

Chart 9: EDF does not appear to benefit much from The CO-Firm's ACT scenario versus the "central" scenario.



Source: Kepler Cheuvreux; "Interpolated Consensus" baseline represents current valuations, as per Bloomberg valuation Excel tools and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other data based on The CO-Firm ClimateXcellence model



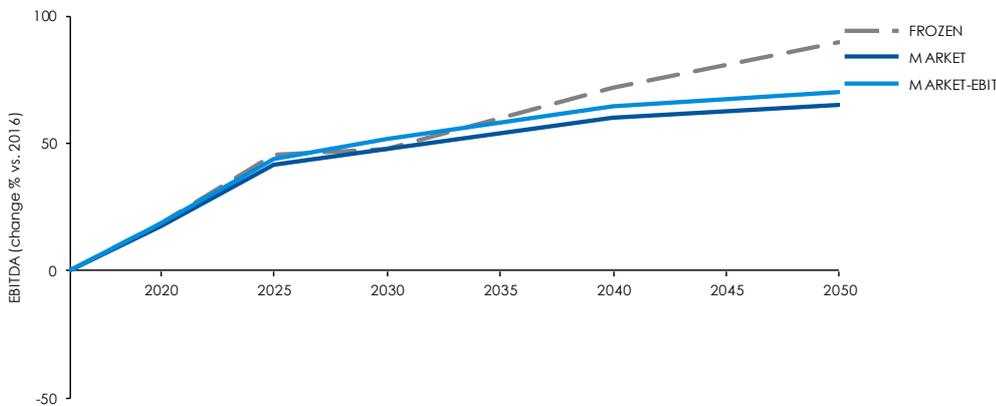
Approach to scenario analysis [\(link\)](#)

2016 annual report [\(link\)](#)

These results are based on specific scenarios and adaptive pathways

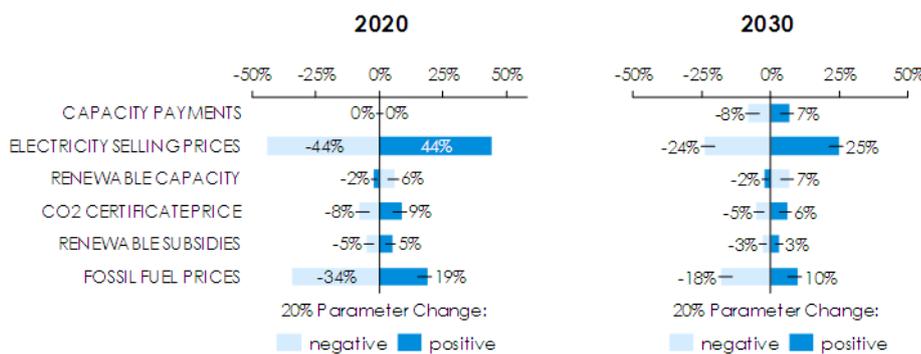
With its newly-announced solar plan, EDF might benefit more in a ACT (2°C) scenario than this graph shows

Chart 10: Zooming in, EDF, with its focus on nuclear and water technologies in France, profits from required capacity payments, which generate sufficient contribution margins to cover long-run production costs for its capital-intensive technologies.



Source: The CO-Firm

Chart 11: Zooming in, EDF's EBITDA is sensitive to changing electricity spot and fuel prices and volatile market situations that can result in supply-demand gaps due to France's market structure.



Source: The CO-Firm

Keep in mind that FROZEN pathway is incompatible with the outlined scenarios and for illustrative purposes only

In 2030, a significant share of EDF's EBITDA is set to come from outside the power market (e.g. capacity payments), which reduces sensitivities over all

Engagement questions:

- **First chart:** In addition to scenario analysis for physical risks ([link](#)), are you planning to perform and disclose data on transition scenarios (beyond commodity and carbon price scenarios), and potentially its interplay with the work you have already done? How is the internal process organised on this type of work?
- **Second and third charts:** What do your investment plans look like, especially with regard to potential growth markets and gas in Italy?
- **Fourth chart:** How are you mitigating potential fossil fuel price risks?

Electric utilities in climate transition

This section complements the *Investor primer to transition risk analysis* report published by Kepler Cheuvreux and The CO-Firm, which provides a more detailed discussion of the concepts and analytical steps described below. It also builds on research published in:

- **Developing an Asset Owner Climate Change Strategy, UN Principles for Sustainable Investment (January 2016, [link](#)).**
- **Feeling the heat: An investors' guide to measuring business risk from carbon and energy regulation, University of Cambridge Institute for Sustainability Leadership (CISL) (May 2016, [link](#)).**
- **Environmental risk analysis by financial institutions - a review of global practice, Cambridge Institute for Sustainability Leadership (CISL) (September 2016, [link](#)).**
- **G20 Green Finance Synthesis Report 2017, G20 Green Finance Study Group (July 2017, [link](#)).**
- **The Transition Risk-o-Meter: Reference Scenarios for Financial Analysis (2° C Investing Initiative, The CO-Firm, June 2017, [link](#)).**
- **Climate Change Analysis: First Aid Kit, Kepler Cheuvreux, (Julie Raynaud, March 2017, [link](#)).**
- **Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities, TCFD (June 2017, [link](#)).**

Changing energy landscape and financial impact

As nations around the globe seek to decarbonise their economies in order to limit global temperature increases, electric utilities face a range of challenges. Depending on the scenario applied, the power sector, currently the biggest emitter of global CO₂ emissions, needs to significantly change the way it produces electricity.

The changes needed (especially with respect to target to keep temperature increases to below 2°C) will continue to pose threats to power companies' traditional business models, which primarily rely on burning carbon-intensive fuels like coal, oil, and gas.

The transition of the German electricity system (*Energiewende*) is a good example what happens to the business models of "traditional" utilities.

- Increased amounts of renewable generation capacities have led to a drop in wholesale electricity prices, as solar and wind power, whose marginal production costs are close to zero, are able to satisfy Germany's electricity demand for an increasing time period.
- As a result, the average utilisation rate of fossil-fuelled power plants has fallen drastically, and companies are forced to mothball plants as the low utilisation rates and low market prices do not recover long-run production costs (The Guardian 2013).

The power sector, currently the biggest emitter of global CO₂ emissions, needs to significantly change the way it produces electricity

- The impact of the German energy transition on utilities is significant: The market value of the three major German utilities, E.ON (-65%), RWE (-77%) and EnBW (-40%), dropped as the transition sped up between 2011 and 2016 ([link](#)).

In addition, an increasing share of renewables is not the only challenge that utilities face, as policy interventions, e.g. carbon pricing or subsidising renewables, change the game as well.

Long-term transition risks may materialise sooner than expected

In a series of reports, Kepler Cheuvreux's Head of Utilities, Ingo Becker, took a closer look at the technological revolution underway in the utilities sector and the pressure on the older assets in a broader context. The decline in European utilities' (e.g. EDF, RWE, or EON) share prices along with the business challenges deriving from both policy and technology setbacks suggest that long-term transition risks could end up materialising sooner than expected. Ingo has been predicting transition risks will eat into conventional business in three phases: 1) conventional generation, which largely happened in the first half of the decade (that he anticipated in January 2009, and all following years, in Welcome to the jungle note, ongoing; 2) retail, here is where the next crash happens (The story of light, March 2016), which started last year (2017) and is set to continue; 3) networks, last layer, which is too early to model but that Ingo has been repeatedly flagging for 2 years.

Hence, anticipating and embracing the changes to come and adjusting business strategies accordingly is key for utility companies in the struggle to survive in a changing market environment.

The utilities' sector recent history already provides multiple examples of successful complete transformations from "old", or "brown", assets to a majority of or entire focus on "new", or "green", assets. In all cases, we argue that, alongside governments' policies, governance and organisational or shareholding structure considerations (e.g. a proper valuation of the assets in the case of spinoffs) were instrumental to varying degrees in driving these strategic portfolio reshuffles:

- **ERG:** Through the planned sales of its downstream oil business, ERG is on the brink of completing its transformation from an oil company (the largest independent operator in downstream oil in Italy) into a nearly pure renewable company (largest player in Italian wind generation thanks to its external growth and its presence in hydroelectric generation in Italy). It still has a CCGT power plant in Sicily. The gradual shift began in 2001 in part because the refinery business was not as profitable.
- **E.ON:** The company sold its conventional energy assets to Uniper, which began operations on 1 January 2016. The current CEO, Dr. Johannes Teyssen, remained at the helm of E.ON, while the former CFO of E.ON became CEO of Uniper. E.ON's focus is on energy networks (Germany, Sweden, CEE and Turkey), customer solutions (Germany, the UK, other) and renewables (Europe, North

The decline in European utilities' (e.g. EDF, RWE, or EON) share prices along with the business challenges deriving from both policy and technology setbacks suggest that long-term issues may come sooner than many in the market predicted (see our Head of Utilities, Ingo Becker series of reports that anticipated the challenges of their conventional business)

The utilities' sector recent history provides multiple examples of successful complete transformations

America). The domestic nuclear business (Preussen Elektra) remained within the group. The remaining (46.65%) stake in Uniper is set to be sold in 2018, while Uniper is currently subjected to a bid from Fortum. E.ON's renewable energy generation in the US and Europe is mostly onshore and offshore wind.

- **Innogy:** The group was floated in 2016 based on plans of then RWE AG's CEO Peter Terium. It is a new energy company made up of RWE AG's grid, retail and renewables businesses.
- **Orsted:** World's largest offshore wind farm company. Orsted is investing in wind and agreed to divest the entire share capital of its upstream oil and gas business to INEOS in May 2017.

The CO-Firm's transition and adaptation scenarios

One approach that allows companies to anticipate climate transition risks, avoid disjointed shifts and financial losses as well as determine the resilience of their business strategies is scenario analysis.

As part of the ET Risk project, two transition scenarios have been developed, namely the Limited Climate Transition (LCT) and the Ambitious Climate Transition (ACT) scenarios. Both scenarios are based on the IEA's Energy Technology Perspective 2017 which are further operationalised. The operationalisation includes the breakdown of IEA's global/regional data to the country levels and the complementation of scenario data with a consistent narrative about regulatory, technology and market-related changes. We note that the paths we outline are being developed gradually, in what appears to be a smooth transition. A disruptive or disjointed climate transformation could result in more severe financial impacts, but this falls outside of the scope of this report. Table 2 lays out the two scenarios briefly. For more information, see the *Transition-risk-o-meter* report.

One approach that allows companies to anticipate climate transition risks is scenario analysis

Table 2: Our two decarbonisation scenarios

Limited Climate Transition (LCT)	Ambitious Climate Transition (ACT)
Operationalised IEA Reference Technology Scenario (RTS) from the 2017 Energy Technology Perspective (ETP) report, i.e. complemented with regulatory, technological and market-related changes	Operationalised IEA 2°C Scenario (2DS) from the 2017 Energy Technology Perspective (ETP) report, i.e. complemented with regulatory, technological and market-related changes
Average temperature increases of 2.7° C by 2100	Average temperature increase of 2.0° C by 2100
Share of renewable in generation mix increases to 41% in 2050 (from 23% in 2014), but fossil fuels still major source for electricity generation	Share of renewable in generation mix increases to 84% in 2050 (from 23% in 2014), being the largest energy carrier, but fossil fuels w/o carbon capture and storage (CCS) nearly phased out
Carbon intensity of electricity production decreases by 46% but absolute emissions increase by 7%	Carbon intensity of electricity production decreases by 94% and absolute emission decrease by 84%
Electricity production nearly doubles	Electricity production increases by 80%
CO2 certificate prices reach EUR50 per tonne of CO2 in 2050 in developed countries, but no CO2 prices in developing countries	Global introduction of CO2 prices that converge gradually at c. EUR180 per tonne of CO2 in 2050

Source: The CO-Firm; IEA Energy Technology Perspective 2017; IEA World Energy Outlook 2017

While this report relies on the two climate transition scenarios outlined in Table 2, at some points, it refers to the well-known IEA scenarios from the World Energy Outlook (WEO) and Energy Technology Perspective (ETP) reports. To give the reader guidance in the discussion of available scenarios, Table 3 presents a classification and quick overview.

Table 3: Classification of scenarios used and referred to in this report

	Description	Baseline scenario	2°C scenario
This report	Operationalised scenarios of the Energy Technology Perspective (ETP) report, i.e. complemented with changes in regulation, technology and markets. See "Investor primer to transition risk analysis" appendix and "The Transition-Risk-O-Meter" report for more information.	Limited Climate Transition (LCT) , which is an operationalised IEA Reference Technology Scenario (RTS) from the 2017 Energy Technology Perspective (ETP) report.	Ambitious Climate Transition (ACT) , which is an operationalised IEA Reference Technology Scenario (RTS) from the 2017 Energy Technology Perspective (ETP) report.
The IEA's Energy Technology Perspective (ETP), 2017	The ETP focuses on the scenario analysis of lower-carbon technology development and deployment in various sectors. It lays out "least-cost" energy system development pathways and emission trajectories.	The Reference Technology Scenario (RTS) corresponds to global warming of 2.7° C until 2100. It provides a baseline scenario that takes into account existing energy- and climate-related commitments by countries, including Nationally Determined Contributions pledged under the Paris Agreement. The RTS, reflecting the world's current ambitions, is not consistent with achieving global climate mitigation objectives, but it would still represent a significant shift from a historical "business as usual" approach.	The 2°C Scenario (2DS) corresponds to global warming of 2.0° C until 2100. It sets out a rapid decarbonisation pathway in line with international policy goals. The 2DS has been the main climate scenario in the ETP series for many years, and it has been widely used by policy makers and business stakeholders to assess their climate strategies.
The IEA's World Energy Outlook (WEO), 2017	The give a full update of energy demand and supply projections to 2040 under different scenarios, and their consequences for energy security, economic prosperity, efficiency, investment, air quality and climate change.	The New Policies Scenario (NPS) , corresponds to global warming of 2.7° C until 2100. The WEO central scenario incorporates existing energy policies as well as an assessment of the results likely to stem from the implementation of announced policy intentions.	The Sustainable Development Scenario (SDS) corresponds to global warming of 1.7-1.8° C until 2100. It was first introduced in the WEO-2017 and is the successor of the 450 Scenario . The SDS starts with a certain vision and then works back to the present. This vision includes three goals, universal access to energy services, fulfilment of the Paris Agreement, reduction of energy-related pollutants.

Source: The CO-Firm, the IEA's Energy Technology Perspective 2017; the IEA's World Energy Outlook 2017

The CO-Firm tests the impact of these scenarios on key financial metrics (EBITDA, EBIT, and depreciation).

- EBITDA covers direct earnings from electricity generation activities only. These include earnings from the electricity spot market, long-term capacity markets or capacity payments, short-term auxiliary services and subsidies for renewable energies.
- EBIT is calculated by subtracting depreciation from EBITDA, deliberately neglecting amortisation, as it is outside the scope.

Guidance in the scenario jungle: Embedding our results in the context of well-known IEA scenarios

The CO-Firm tests for the impact of these scenarios on key financial metrics (EBITDA, EBIT, depreciation and discounted cash flows)

- Depreciation for individual technologies is calculated based on the start-up year, an average technology-specific lifetime and a 7.5% discount factor.
- As an outlook, discounted cash flows based on the metric outlined above for a given discount factor will be provided in the future

Due to our analysis's high climate sensitivity, it is strictly focussed on grid-connected electricity generation. Nonetheless, multi-utility companies typical have other income streams beside power generation, such as power transmission, natural gas, or district heat supply.

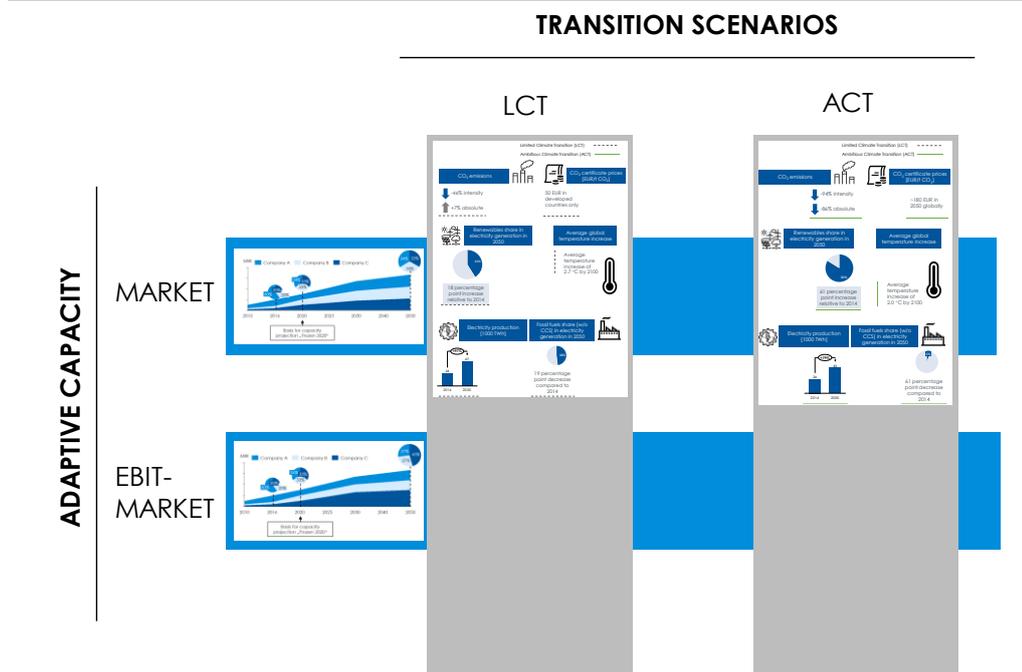
The CO-Firm thinks that companies can adapt to changing market environments, among others, by altering their business strategies. In terms of the underlying method, this does imply that companies have perfect foresight until 2050; rather companies can adapt their strategy in time to the gradual changes outlined in the scenario (see Appendix). In the context of electric utilities, altered business strategies can be translated into different possible future technological pathways.

Adaptation strategies can include investing in renewable technologies in growing markets under the ambitious climate scenario. Groups' adaptive capacity depends, in part, on their financial strength, their current and planned technology structure, with respect to technology type and global diversity, relative to the scenario's regional technology development and the business case requirements to achieve this development, such as feed-in-tariffs, capacity payments, and others). The CO-Firm limits market entry, though, to ensure comparability between existing companies.

With this perspective on adaptive capacity, The CO-Firm implicitly makes assumptions on managerial capacity to identify market sweet spots, and to affect growth in key plant technologies, etc. It does not make distinctions due to various propensities to influence public sector decision making processes, as these tend to be analysed by analysts today already, and analysts can apply their proprietary information in interpreting the results. Accordingly, The CO-Firm's modelling assumes that all regulatory benefits or penalties apply to comparable power plants in the same region through the same mechanisms.

The CO-Firm thinks that companies can adapt to changing market environments, among others, by altering their business strategy

Chart 12: The two Climate Transition scenarios and two adaptive capacities result in four climate/adaptation combinations



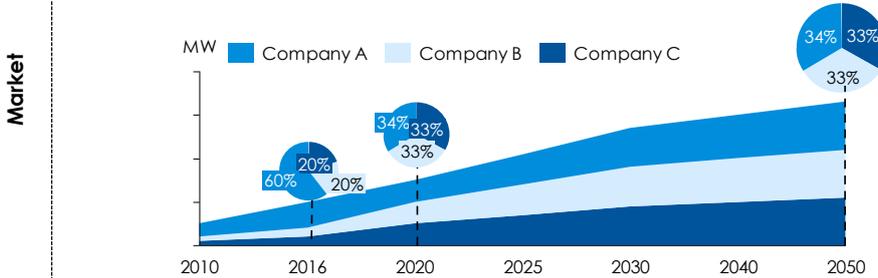
Source: The CO-Firm

Such adaptation scenarios are included in our analysis through companies' technology mix. Focussing on technology is crucial here, since a country's technology mix determines (to a large extent) power market prices, and a company's technology mix shapes its economic performance (see page 34). The CO-Firm distinguishes between two adaptive pathways or strategic approaches where companies adapt to changes based on their capacities. The first, the "Market" scenario expects companies to maintain market shares in terms of countries and technologies. The second scenario, "Market EBIT", acknowledges that financially strong companies (higher EBIT) have greater potential to capture a larger share of growth (Chart 13; for further information, see page 13). For illustrative purposes a "Frozen" portfolio is laid out, which looks at the impact of a stable company portfolio as of 2020. It is important to note that "Frozen" is neither a company strategy nor a consistent pathway for the outlined scenarios (Chart 13).

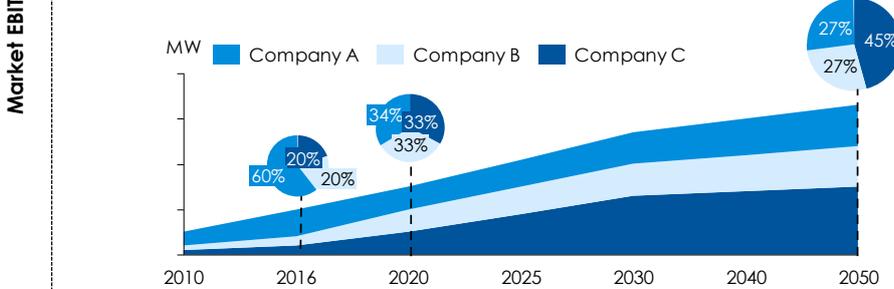
The CO-Firm distinguishes between two adaptive pathways or strategic approaches where companies adapt to changes based on their capacities

Chart 13: Three adaptive capacity assumptions to forecast companies' asset development

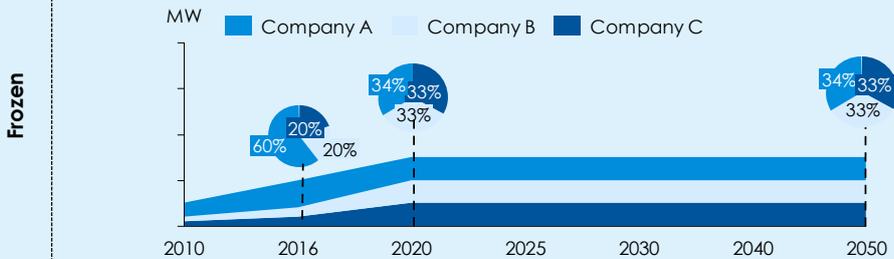
Describes asset development fully in line with the market developments outlined in the scenario. For instance, a 20% renewable capacity upgrade in one country corresponds to a 20% increase in renewable capacity across all utilities operating in this country, taking into account their current shares of renewables.



Builds on the market scenario but also includes companies' financial strength over time, assuming that financially strong companies can invest more in growing technologies. A company's overall EBIT serves as an indication of its financial strength. This is put into a non-linear function to the average total EBIT across all companies. This function ensures that the company with the strongest EBIT is able to gain twice the share of new renewable investment compared to the companies with average EBIT strength, while the weakest companies get half the share of the average-EBIT company.



Asset structure in 2020 is frozen until 2050. This considers new projects plans and shutdowns until 2020 (based on Platt's World Electric Power Plant database from June 2017). It needs to be noted that freezing technologies leads to inconsistency with the scenarios outlined, thus a frozen development serves only as an indication.



Source: The CO-Firm, Kepler Cheuvreux

Scenario-based risk analysis: Results

This section presents The CO-Firm's risk analysis results in six subsections.

- The first step outlines the impact on financial KPIs (i.e., EBITDA, EBIT and depreciation) for ENEL, Engie, EDF and the global utilities sector under our two climate transition scenarios.
- The second to fifth steps show global utility and company-specific deep-dives into the financial impacts, technological portfolio development and the robustness of earnings with the help of company/technology-specific sensitivity analyses.
- The sixth and last step looks at companies' financial performance with the help of country/technology-specific EBITDA heatmaps and discusses the underlying rationale.

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

EDF, ENEL and Engie: potential for global EBITDA growth

What are the key takeaways?

Good news first, the electric utilities sector can profit from global power demand growth, in general, as well as large investments in renewable assets in climate transition in such a way that overall EBITDA grows in both scenarios. However, our analysis shows company- and country-specific differences:

- ENEL, Engie and the electric utilities sector on average have stronger EBITDA growth in the ambitious climate transition (ACT) scenario than in the limited climate transition (LCT) scenario.
- EDF and ENEL are able to outperform the average EBITDA growth of the global electric utilities sector by adapting their technology structures to the specific scenario. Adaptation strategies include investments in renewable technologies in growing markets under the ACT scenario.
- Without adaptation, meaning freezing their physical technology structures as of 2020, while still considering new projects (based on Platt's World Electric Power Plant data from June 2017 up to then, ENEL's and Engie's EBITDA decreases.

This section presents the CO-Firm risk analysis results in six subsections

Overall, the electric utilities sector can see a positive EBITDA development in ACT and LCT, due to global power demand growth, as well as large investment requirements in renewable assets

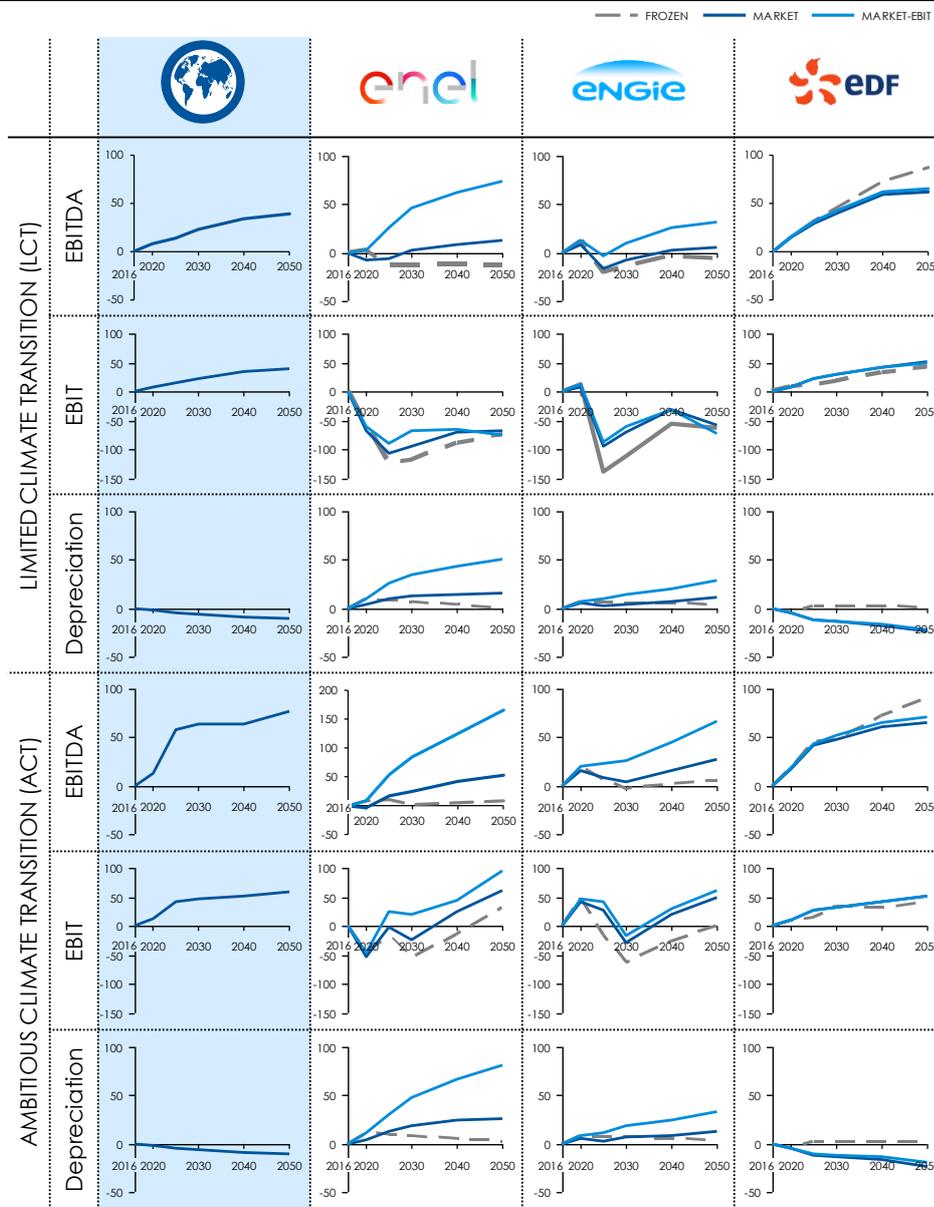
Bottom-line, having a favorable market and technology combination separates the winners from the losers in the electric utilities sector. Thus, we outline EBITDA changes based on technology and country combinations in the following heatmaps.

What are the impacts on financial KPIs?

Chart 14 shows the percentage change in relation to 2016 EBITDA, EBIT and depreciation for the electricity generating technologies of these three companies and the sector average under the two scenarios laid out above. It makes three technological development assumptions, namely frozen (freeze technology structure in 2020), market (linear development along market transformation) and market-EBIT (financially strong companies can invest more in growing technologies).

It is important to remember that scenarios are both plausible and consistent but are not associated with likelihoods. While market developments can be seen as conservative, EBIT development shows an optimistic case in which companies adopt renewable energies heavily. Freezing companies' technology leads to implausibility and inconsistency with our scenarios outlined, thus this scenario is for comparative and illustrative purposes only.

Chart 14: Relative percentage change in relation to 2016 EBITDA, EBIT and depreciation in ACT and LCT scenarios (ENEL, Engie, EDF and the average of the electric utilities sector) with and without adaptive capacity (adaptive capacity does not apply to the global sector level).



Source: The CO-Firm

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

When adaptive capacity is measured in relation to performance of the global sector, the adaptive capacities of the global sector is always the same (see the "Changing Color" report for more information)

Deep-dive into the global electric utilities sector

Why do earnings of the global electric utilities sector increase under both scenarios overall?

Looking at the global average, EBITDA grows significantly under the ACT scenario compared to the LCT scenario. EBITDA increases significantly in the ACT scenario due to four reasons:

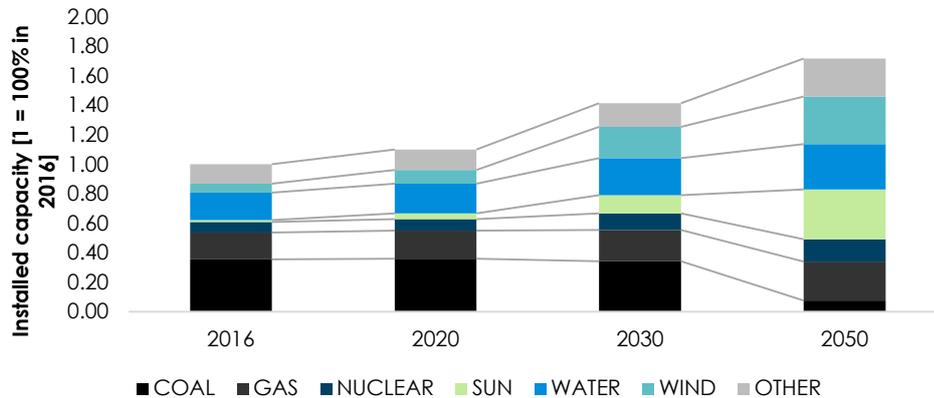
- **The introduction of CO2 certificate prices** in most markets after 2020 is likely to increase electricity prices and thus average earnings except for carbon-intensive coal technologies. While CO2 certificate prices increase gradually over time, with increasing renewable and decreasing fossil fuel shares, the effect of CO2 certificate prices on EBITDA does not increase similarly.
- **Introducing capacity markets after 2025:** In most countries, electricity market prices will fall in the long run to a point at which asset operators cannot recover long-run production costs by selling electricity to the market. The reasons for falling prices, despite increasing CO2 certificate prices, are greater renewable capacities with close to zero short-run marginal production costs and falling fossil fuel prices (mainly on lower demand). In these countries, we assume that regulators will gradually introduce capacity markets after 2025 to ensure operation of and investment in conventional technologies, as outlined by the scenarios.
- **Significant capacity upgrades:** We note that renewable energy technologies have fewer full load hours, or capacity factors, partly due to their fluctuating supply, than conventional electricity generation technology. Thus, replacing one megawatt of conventional power could mean installing two or more megawatts of renewable energy.
- **Growth of electricity demand** due to population and GDP growth and electrification (e.g. switch from combustion engines to battery electric vehicles), despite energy efficiency gains. More electricity demand is a main driver for the EBITDA increase in the LCT scenario.

How does the technology portfolio change?

In the ACT scenario, the global electricity generation capacity available to the grid increases by more than 70% by 2050 to cover demand increases and accounts for the lower load factors from a higher share of renewable energies. Wind and solar technologies (photovoltaics and solar thermal) will likely increase markedly. Gas will still play a key role, but other fossil fuel technologies like coal are likely to decrease significantly. Nuclear capacities may increase slightly, but most additional capacities come from investments in wind and solar.

Capacity market can provide the answer to the "missing money" problem: when prices for electricity in competitive wholesale electricity markets do not fully reflect the value of investment in the resources needed for reliable electric services

Chart 15: Global technology portfolio development in the ACT scenario



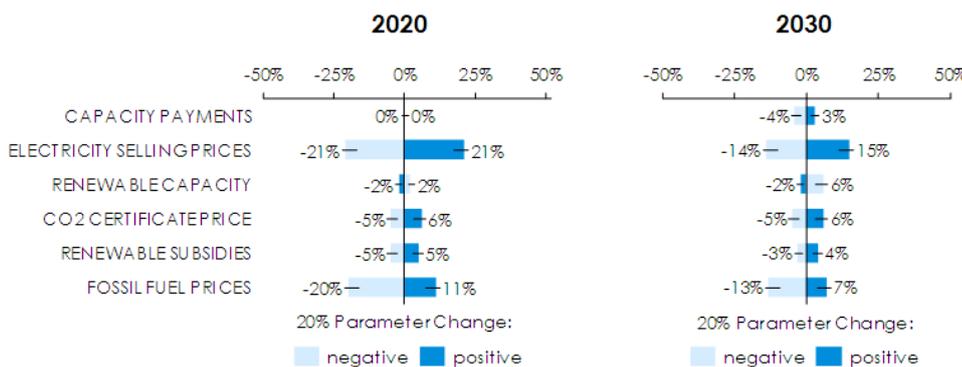
Coal: energy carrier coal and lignite and all its electricity generating technologies
 Sun: photovoltaics and solar thermal technologies
 Wind: offshore and onshore wind
 Other: all remaining energy carrier and electricity generation technologies (more than 30) whose characteristics cannot be included in one of the other six categories. It is important to note that this include carbon-intensive elements like oil as well as low carbon energy carriers and technologies like wood, geothermal, biomass, etc.

Source: The CO-Firm

How robust are the earnings?

In general, global EBITDA is more sensitive to external shocks in 2020 than in 2030. This is due to the fact that global EBITDA increases significantly and external shocks of $\pm 20\%$ will have relatively less impact. Furthermore, due to increased renewable capacities, supply and demand will be more balanced, and external shocks have to be more significant to cause large impacts.

Chart 16: Global electric utilities sector EBITDA sensitivities



Source: The CO-Firm

Deep-dive into Engie

What are the key takeaways?

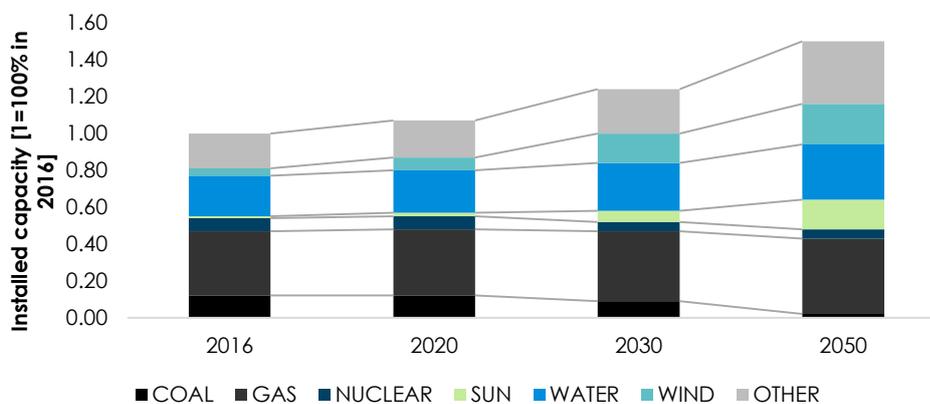
Engie, with gas, water, and coal technologies (relatively comparable with ENEL in terms of technology mix), is able to increase EBITDA in the long run in both scenarios through adaptation.

- The EBITDA increase is less than for ENEL, due to the technology-country combination, as **Engie is quite diversified in gas but not as much in wind and solar technologies.**
- In the **LCT scenario, Engie benefits from the significant improvement in gas technologies** as outlined in the scenario.
- In the **ACT scenario, Engie invests further in renewable technologies**, but not to the same extent as ENEL as its current renewable investments are in less fast-growing countries.

How does the technology portfolio change?

Engie's gas technologies are quite diversified, but its wind and solar activities are not. In the medium term, Engie is set to benefit from the need for additional gas capacities to cover demand peaks under the ACT scenario. It is also investing in renewables, but this increase is only moderate, as it is not currently investing in fast-growing markets. However, it is able to increase its overall installed capacity by c. 50% (Chart 17).

Chart 17: Engie technology portfolio development in the ACT/MARKET EBIT scenario



Coal: energy carrier coal and lignite and all its electricity generating technologies

Sun: photovoltaics and solar thermal technologies

Wind: offshore and onshore wind

Other: all remaining energy carrier and electricity generation technologies (more than 30) whose characteristics cannot be included in one of the other six categories. It is important to note that this include carbon-intensive elements like oil as well as low carbon energy carriers and technologies like wood, geothermal, biomass, etc.

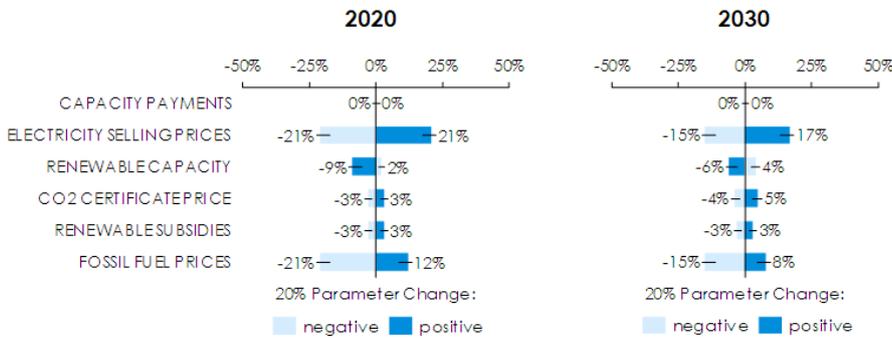
Source: The CO-Firm

How robust are the earnings?

Globally, Engie is particularly sensitive to potential changes in electricity selling prices (Chart 18). Interestingly, the group is comparatively sensitive to increasing shares of renewables in the electricity system. This is due to its technology structure that is, especially in the near term, dominated by

natural gas plants that are going to be pushed down the merit order by greater shares from wind and solar capacities. As Engie's portfolio increases and gets more diversified, external shocks will be less severe on EBITDA.

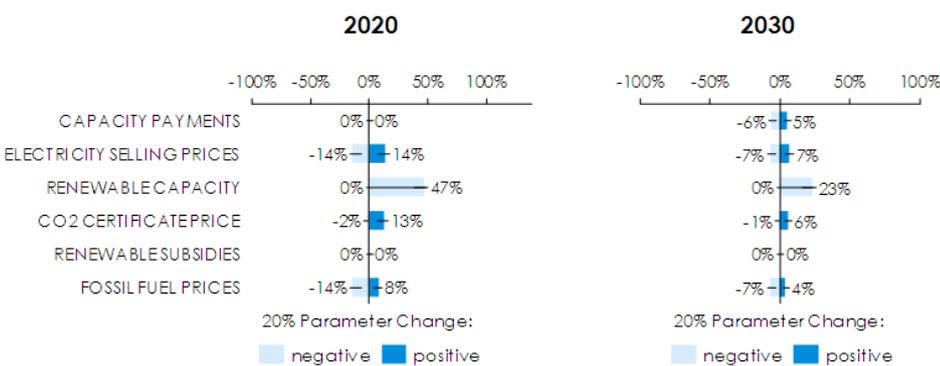
Chart 18: Engie global EBITDA sensitivity analysis



Source: The CO-Firm

Taking the example of natural gas and additional renewables in Italy, the effect of renewables pushing out fossil fuel technologies is even more striking in 2020. In 2030, gas-fired power plants only play a limited role in Italy's electricity system. They can cover their long-term production costs only through payments from the capacity market, since they are needed only to cover demand peaks and load situations without solar or wind. In 2030, a 20% parameter change would be insufficient to cause significant impacts on gas technologies (Chart 19).

Chart 19: EBITDA sensitivities of Engie's natural gas portfolio in Italy



Source: The CO-Firm

Deep-dive into ENEL

What are the key takeaways?

ENEL's future performance depends on the scenario and group behaviour.

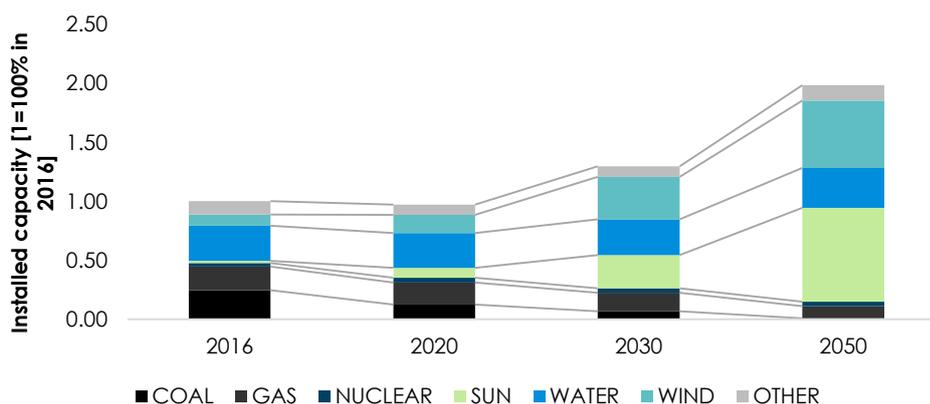
- As the group has the financial strength and is invested in water, wind, and solar in growing markets, **it has the adaptive capacity for a large-scale transformation of its technology structure over the next 30 years** by phasing out coal and gas technologies while investing more in renewable energy.
- This transformation **pays off well in the ACT scenario** with stronger EBITDA and EBIT increases than for EDF and Engie.
- With fewer renewable capacity upgrades and less financial strength due to no global introduction of CO2 prices, **ENEL's adaptive capacity is lower in the LCT scenario**. Still, no adaptation yields the lowest EBITDA development.

How does the technology portfolio change?

Having a technologically well-diversified portfolio and especially being invested in renewable energies in growing markets today, ENEL has the adaptive capacity for a large-scale transformation of its technology structure over the next 30 years by phasing out carbon-intensive technologies and investing in wind and solar (Chart 20). This results in a near doubling of total installed capacity. This asset development assumes that ENEL continues its shift in capital allocation towards renewables. Still, with its New Strategic Plan (2018-20) announced in November 2017, ENEL's portfolio development might look different than Chart 20 shows.

ENEL has the adaptive capacity for a large-scale transformation of its technology structure

Chart 20: ENEL technology portfolio development in the ACT/MARKET EBIT scenario%



Coal: energy carrier coal and lignite and all its electricity generating technologies

Sun: photovoltaics and solar thermal technologies

Wind: offshore and onshore wind

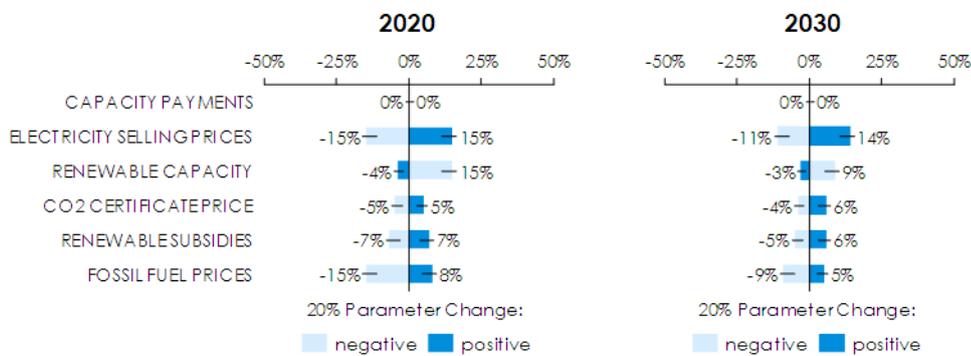
Other: all remaining energy carrier and electricity generation technologies (more than 30) whose characteristics cannot be included in one of the other six categories. It is important to note that this includes carbon-intensive elements like oil as well as low carbon energy carriers and technologies like wood, geothermal, biomass, etc.

Source: The CO-Firm

How robust are the earnings?

Apart from electricity demand changes (see a detailed explanation of this effect in the EDF section), ENEL is particularly sensitive to reduced fossil fuel prices in 2020 (Chart 21). A 20% reduction in fossil fuel prices would result in a 15% reduction in overall EBITDA, since falling fuel prices lead to falling spot market prices and lower the contribution margin for all technologies. In 2030, due to further technology portfolio diversification and the development of renewable energies in the market-EBIT scenario, ENEL is very resistant to external shocks. Even changes in renewable subsidies have a limited impact on ENEL's EBITDA, since renewables are fairly competitive in the ACT scenario by 2030 and subsidies are less important.

Chart 21: ENEL global EBITDA sensitivity analysis

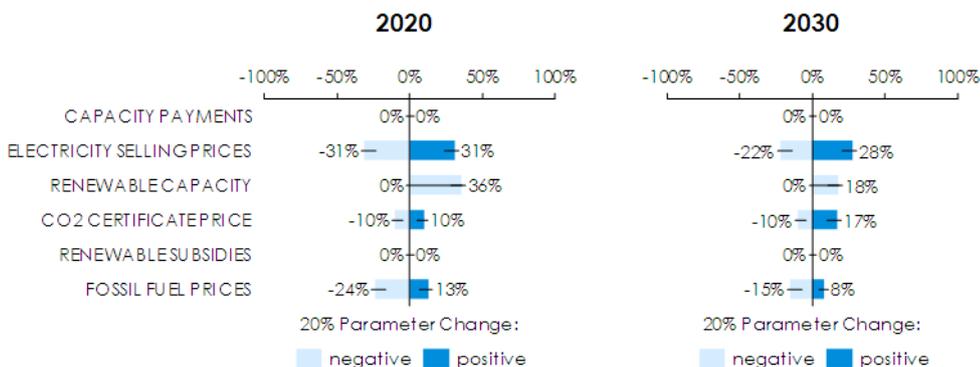


Source: The CO-Firm

Most of ENEL's technologies are in Italy with water being the major energy carrier. Pumped storage water plants can set prices strategically, as ramp-up times are usually very short and they are independent of (direct) fuel price shocks. However, water plants will be impacted by anything that directly or indirectly affects electricity spot prices, since they push the whole market up or down. In 2030, this effect is lower than in 2020, since supply and demand will be more balanced through additional renewable installations that cushion external shocks (Chart 22).

The majority of ENEL's technologies are located in Italy with water being the major energy carrier

Chart 22: EBITDA sensitivities of ENEL's water portfolio in Italy



Source: The CO-Firm

Deep-dive into EDF

What are the key takeaways?

EDF is an exception to the rule, as it has the highest EBITDA growth without adaption and is by far the largest electricity generator in a country (France). Given that France is set to undergo a partial nuclear phase-out by 2050, in line with the European Commission's trend scenario, it generates less earnings than in a "Frozen" scenario, which would keep all nuclear technologies (assuming regulatory support via capacity payments).

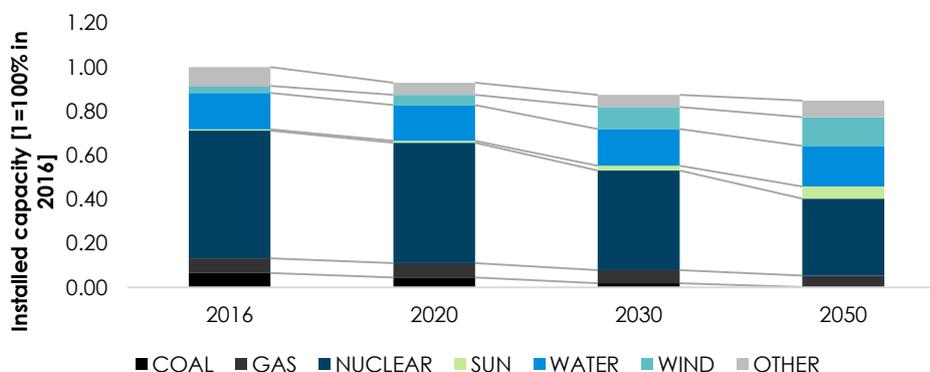
- **EDF shows steady increases in EBITDA and EBIT in all scenarios and adaptive capacities.** The group is focussed on nuclear and water technologies in France. In the long term, it depends on capacity payments to generate sufficient contribution margins to cover long-run production costs for capital-intensive technologies.
- Neither increasing fossil fuel prices in the LCT scenario nor increasing CO2 prices in the ACT scenario are sufficient to revive low-price electricity markets in the long term in France.
- Assuming a partial **nuclear phase-out in France** in line with the European Commission's trend scenario, **EDF would cut its nuclear technologies over time, which decreases depreciation** as well as EBIT and EBITDA, versus the adaptive capacity development.

How does the technology portfolio change?

In the ACT scenario (EBIT), EDF loses about 10% of its installed capacity, mainly due to the proposed nuclear phase-out in France (Chart 23). The nuclear capacity reduction as well as the phase-out of EDF's coal technologies cannot be offset by a comparatively low build-out of renewables in France and other markets. This asset development assumes that EDF continues its investment in renewable energy. Still, with its newly-announced solar plan, EDF might have more sun capacities in a 2°C scenario than Chart 23 shows.

The nuclear capacity reduction, as well as the phase-out of EDF's coal technologies, cannot be offset by a comparatively low build-out of renewables in France and other markets

Chart 23: EDF technology portfolio development in the ACT/Market EBIT scenario



Coal: energy carrier coal and lignite and all its electricity generating technologies

Sun: photovoltaics and solar thermal technologies

Wind: offshore and onshore wind

Other: all remaining energy carrier and electricity generation technologies (more than 30) whose characteristics cannot be included in one of the other six categories. It is important to note that this include carbon-intensive elements like oil as well as low carbon energy carriers and technologies like wood, geothermal, biomass, etc.

Source: The CO-Firm

How robust are earnings?

In 2020, EDF is highly sensitive to a change in electricity and fossil fuel prices.

A 20% reduction in electricity market prices would cut EDF's EBITDA by 44%, whereas a 20% increase in global electricity demand even would result in a 44% increase in EBITDA (Chart 24). The high sensitivity to prices can be explained by EDF's power plant portfolio that is focussed mainly on nuclear and water power plants in France and the French power market situation.

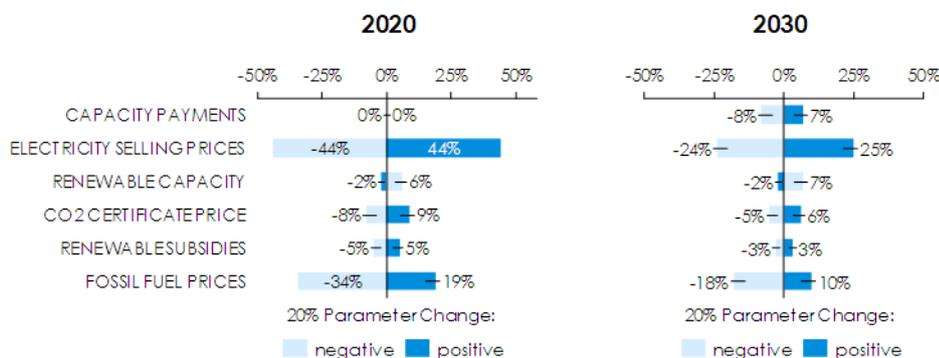
Nuclear and water technologies are setting the merit-order-based electricity market price at half the level, depending on the time of the year. In these situations, these two technologies only get the price from the power market that is sufficient to cover their short-run marginal production costs.

Incrementally higher electricity prices, either directly through electricity price variations or indirectly through fossil fuel price variations, could start to generate earnings. Although fossil fuel technology seldom sets the market price in France, fossil fuel price variation does impact the boarder price for electricity imports, e.g. from fossil fuel-intensive power markets like Germany.

In 2030, the significance of electricity and fossil fuel price variations decreases for EDF. As capacity markets are introduced mainly after 2025, nuclear and water technologies' earnings shift from the energy-only market to the capacity market, making the EBITDA less sensitive to electricity price variations but more sensitive to regulatory actions in the form of capacity markets (i.e. -8% to +7% for a ±20% parameter variation). While the same is true for fossil fuel prices, which indirectly affect electricity prices, decreasing fossil fuel capacities reduce sensitivity to fossil fuel price variations.

The high sensitivity to prices can be explained by EDF's power plant portfolio that is focused mainly on nuclear and water power plants in France and the French power market situation

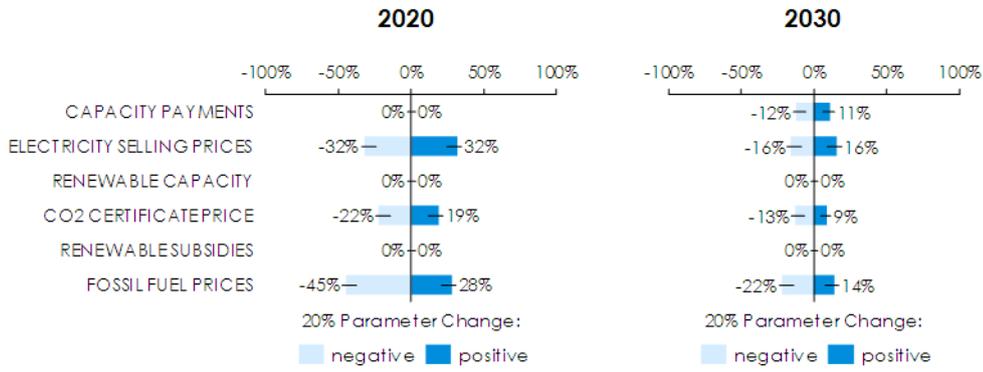
Chart 24: EDF global EBITDA sensitivity analysis



Source: The CO-Firm

Focussing only on EDF's nuclear portfolio in France, it is evident that this technology is driving EDF's EBITDA: the analysed effects of a ±20% change in parameters of the nuclear portfolio in France (Chart 25) are similar (shape and intensity) to the effects observed overall (Chart 24).

Chart 25: EBITDA sensitivities of EDF's nuclear portfolio in France



Source: The CO-Firm

Financial performance diagnostic with country/technology heatmaps

In this subsection, The CO-Firm analyses the three companies' financial performance with the help of country- and technology-specific EBITDA heatmaps. It outlines the key findings before deep-diving into heatmaps for 2020, 2030 and 2050. It closes with the rationale behind the relationship between country/technology combinations and financial performance.

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

What are the key findings from our heatmaps?

Across all countries and scenarios, the key findings from performance diagnostics and heatmaps are summarised in Chart 26:

- **LCT and ACT scenarios see similar dynamics.** Generally, the LCT's EBITDA impacts are also seen in the ACT, but they will be stronger in the ACT scenario.
- **Renewables, water, and nuclear win in absolute EBITDA.** Solar, wind, water, and nuclear technologies are the winners of the transformation in absolute EBITDA terms, especially in the long run. Some exceptions are: water in Italy, which only benefits in the ACT scenario and only in the long run (after 2030); nuclear and water in Mexico, with positive impacts after 2020 and 2030, respectively; and nuclear in Germany, as it is being phased out beyond 2023. Despite decreasing capex from learning curve effects, specific earnings from wind and solar technologies decrease steadily over time in all markets and scenarios (stronger in the ACT) due to the cannibalising effects of renewable upgrades in energy-only markets, as well as cuts to or the phasing-out of renewable subsidies. With the exception of Germany, France, and Italy, most capacity upgrades in both scenarios, ranging from 300% to 5000% from 2016 to 2050 (depending on the region), offset particular earning decreases, so an absolute EBITDA increase with investments is possible.
- **Fossil fuels' EBITDA faces increasing pressure, requiring the regulator to jump in.** Coal will see stronger risks to its EBITDA than gas, as CO₂ prices cut into coal's competitiveness in the energy-only market. With increasing CO₂ prices, coal will often become the price-setting technology whose earnings as well as volumes fall. Capacity factors, or full-load hours for coal decrease by one-third in 2030 and by two-

Solar, wind, water, and nuclear are the winners of the transformation in absolute EBITDA terms

Coal will see greater risks to its EBITDA than gas, as CO₂ prices reduce its competitiveness in the energy-only market

thirds in 2050 compared to today. Under these conditions, coal technologies fail to cover long-run production costs, forcing the regulator to steadily phase in capacity payments (capacity markets) on average after 2025 in the ACT and 2030 in the LCT. Gas, commonly perceived as the lesser evil of the two fossil fuel carriers, plays a significant role in both scenarios in 2020-50. Still, gas is facing lesser, but similar, challenges to its EBITDA. CO2 prices decrease its competitiveness, which hurts earnings from energy-only markets, especially those with little or no coal technologies like Italy or France. With decreasing volumes and earnings, gas technologies need capacity payments after 2025 in the ACT scenario (2030 in the LCT scenario) to cover long-run costs, especially when gas often sets the market price (e.g. Germany). In markets with a high share of coal capacities and carbon prices, gas wins over coal (e.g. the US and Mexico).

- **Renewable energy, water, and nuclear benefit more in carbon-intensive markets.** In carbon-intensive environments, CO2 certificate prices have a stronger effect on market prices and earnings. The magnitude of the effect increases with the amount of time carbon-intensive technologies set the market price throughout the year. In these markets, renewable energy, water and nuclear are able to generate the highest specific earnings by installed capacity. Plus, cannibalising effects from renewable upgrades are dampened.

Chart 26: Key findings across all countries and scenarios for performance diagnostics with heatmaps

EBITDA impact							
Earnings from energy-only markets	Renewable capacity upgrades	↓	↓	↓↓	↓↓	↓↓	↓↓
	Fossil fuel price increase	↑	↑	↑	↓	↓	↓
	CO ₂ price increase	↑	↑	↑	↓	↓↓	↓↓
Earnings outside energy-only markets	Capacity payments increase		↑	↑↑	↑	↑↑	↑↑
	Renewable subsidies increase	↑					

Source: The CO-Firm

Deep-dive into the EBITDA heatmap for 2020

Although looking only at a time span of four years, the impact of the ACT scenario can lead to significant EBITDA changes (Chart 27). Winners are renewables energy in Brazil and Mexico and in the rest of the world, gas in the US and nuclear in the rest of the world. With the exception of gas in the US (low gas prices), the main drivers for EBITDA increase are capacity upgrades. The loser is coal in Brazil, France, Germany, Italy, and Mexico due to CO2 price increases in 2020 and renewable capacity upgrades. The same logic applies to gas technologies in Germany and Italy. In both countries, gas assets comparatively often set market prices which result in negative EBITDA changes.

Chart 27: Heatmap of total EBITDA changes for specific country/technology combinations in the Ambitious Climate Transition (ACT) scenario in 2020 versus 2016. A red field implies a decrease in total EBITDA of more than 50% while a green field implies an increase of more than 100% for the specific country/technology combination. For orientation, companies with their country/technology portfolio focus under the Market EBIT development assumptions are highlighted (see below table for details). A company located in a green field could profit from their favourable country/technology combination and for red fields vice versa.

EBITDA ACT 2020 vs. 2016	ROW ^A	BRAZIL ^B	FRANCE ^B	GERMANY ^B	ITALY ^B	MEXICO ^B	USA ^B
COAL	ENGIE			ENGIE	enel		
GAS	ENGIE enel		EDF ENGIE		EDF ENGIE enel		ENGIE
NUCLEAR	EDF		EDF				
SUN							
WATER		ENGIE	EDF		enel		
WIND			ENGIE				enel

A: ROW (Rest of the World) companies highlighted where installed capacity in rest of world is >10% of installed capacity.
 B: Companies highlighted where installed capacity in the country is >2% of installed capacity.
 Color-coding: red ≤-50%, yellow = 0, green ≥+100% change in EBITDA vs. 2016, colour gradients between red, yellow and green indicate values of EBITDA changes.

Source: The CO-Firm

Analyst guidance: The heatmap exclusively highlights findings from a climate risk scenario analysis. As such, it neither contain nor provide any assessment of probabilities. It illustrate relative changes of absolute EBITDA over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. The heatmap do not constitute a financial forecast nor investment advice. See Appendix for more information.

Deep-dive into the EBITDA heatmap for 2030

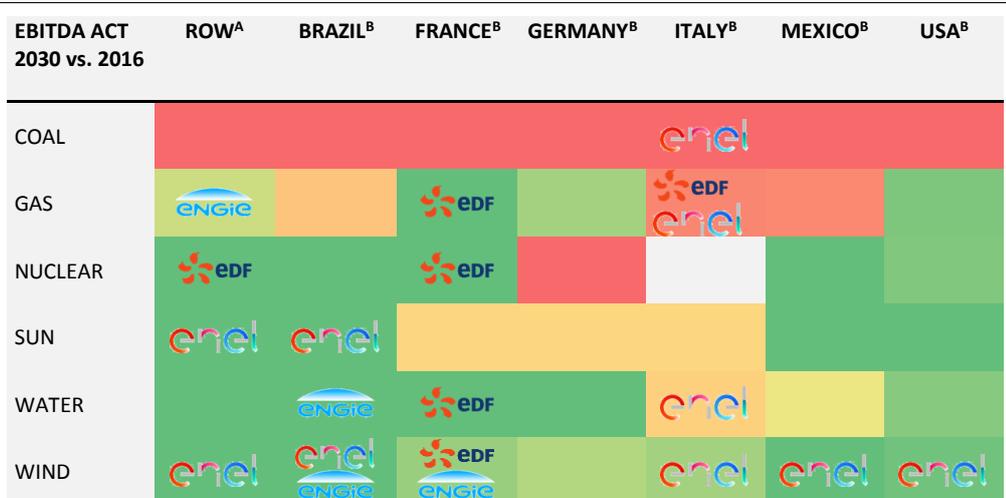
In 2030, EBITDA trends are comparable to those in 2020, but changes are more intense (Chart 28). In particular, renewable energies in Brazil, Mexico, the US, and ROW are able to increase absolute EBITDA by more than 100% compared to 2016. ENEL, as it is invested in renewable energy in growing countries like Brazil, Mexico and ROW, is able to upgrade capacities significantly. An exception to the renewable energy trend is solar in France, Germany, and Italy, where capacity upgrades are able to compensate for decreasing subsidies and cannibalisation effects.

Nuclear technologies benefit in terms of EBITDA grow from the ambitious transformation scenario in all countries, partly due to capacity increases, e.g. in Rest of World, with the exception of Germany due to the nuclear phase-out beyond 2023.

The story of coal is even worse than in 2020, as EBITDA is decreasing by more than 50%, due to volume and competitiveness losses. Engie is decreasing the share of coal in its portfolio share by divesting in Germany and ROW. At the same time, Engie is divesting gas technologies in Italy and France and investing in winning gas markets like the US and selected countries in the rest of the world.

The story of gas EBITDA is still ambiguous in all countries in the ACT scenario, but increasing capacity payments after 2025 make gas in Germany and France in 2030 more profitable than in 2016.

Chart 28: Heatmap of total EBITDA changes for specific country and technology combinations in the Ambitious Climate Transition (ACT) scenario in 2030 versus 2016. A red field implies a decrease in total EBITDA of more than 50%, while green implies an increase of more than 100% for that specific country-technology combination. Companies with their country/technology portfolio focus under the market EBIT development assumptions are highlighted (see table for details). A company in a green field could profit from a favourable country- technology combination and be hurt in red fields.



A: ROW (Rest of the World) companies highlighted where installed capacity in rest of world is >10% of installed capacity.
 B: Companies highlighted where installed capacity in the country is >2% of installed capacity.
 Color-coding: red ≤-50%, yellow = 0, green ≥+100% change in EBITDA vs. 2016, colour gradients between red, yellow and green indicate values of EBITDA changes.

Source: The CO-Firm

Analyst guidance: The heatmap exclusively highlights findings from a climate risk scenario analysis. As such, it neither contain nor provide any assessment of probabilities. It illustrate relative changes of absolute EBITDA over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. The heatmap do not constitute a financial forecast nor investment advice. See Appendix for more information.

Deep-dive into the EBITDA heatmap for 2050

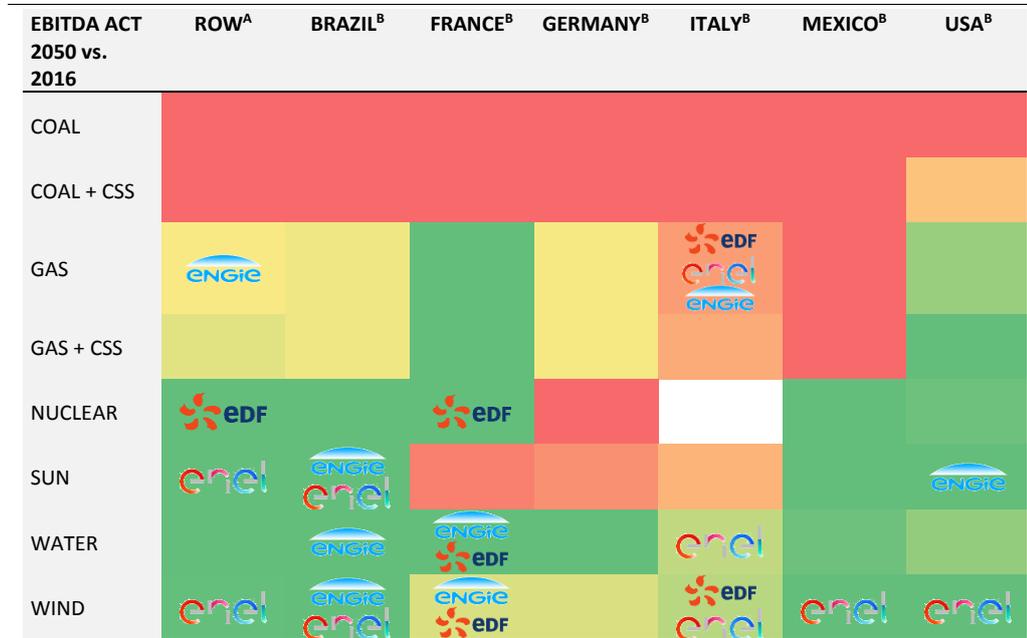
In 2050, a large amount of carbon capture and storage (CCS) is required to meet the ACT scenario. However, CCS is only able to partly compensate for EBITDA decreases for fossil fuels in the US and selected countries like Australia and South Africa. ENEL (pulling out of coal in Germany), Engie and EDF are not strong in coal technologies in countries with CCS, thus none of them invest in this technology.

Compared to 2030, fossil fuels' EBITDA continues to fall, while EBITDA is growing of nuclear, while water and renewable energies are still strong with the exception of solar in France, Germany, and Italy. The story for gas, however, changes as EBITDA growth is stagnant in Brazil, Germany and ROW. While capacity payments partly offset decreasing earnings from markets, capacity payments in 2050 are less important than energy market earnings in 2016.

The story changes for renewable energy suppliers as well. These suppliers will face more competition due to large-scale capacity of renewable power in the market and no subsidies. In this environment, solar technologies in France, Germany, and Italy generate less EBITDA in 2050 than in 2016 (with subsidies). Wind technologies are more competitive without subsidies than solar. The most promising country-technology combinations are solar and wind technologies in Brazil, Mexico, the US and emerging countries in the rest of the world. ENEL and Engie are able to upgrade capacity in these promising combinations and profit from EBITDA grow. In 2050, EDF is set to have significant shares of its generation portfolio from wind power in France. Water is the only technology that shows EBITDA grow across all countries in 2050 compared to 2016. Engie can particularly benefit from capacity upgrades in Brazil.

Most promising country-technology combinations are solar and wind technologies in Brazil

Chart 29: Heatmap of total EBITDA changes for specific country and technology combinations in the Ambitious Climate Transition (ACT) scenario in 2020 vs. 2016. A red field implies a decrease in total EBITDA of more than 50%, while green implies an increase of more than 100% for that specific country-technology combination. Companies with their country/technology portfolio focus under the market EBIT development assumptions are highlighted (see table for details). A company in a green field could profit from a favourable country- technology combination and be hurt in red fields



A: ROW (Rest of the World) companies highlighted where installed capacity in rest of world is >10% of installed capacity.
 B: Companies highlighted where installed capacity in the country is >2% of installed capacity.
 Color-coding: red ≤-50%, yellow = 0, green ≥+100% change in EBITDA vs. 2016, colour gradients between red, yellow and green indicate values of EBITDA changes.

Source: The CO-Firm

Analyst guidance: The heatmap exclusively highlights findings from a climate risk scenario analysis. As such, it neither contain nor provide any assessment of probabilities. It illustrate relative changes of absolute EBITDA over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. The heatmap do not constitute a financial forecast nor investment advice. See Appendix for more information.

Why favourable country-technology combination drives earnings?

The CO-Firm found that a company's performance, in terms of EBITDA, is mostly driven by its current and future technology portfolio, namely its country-technology combination. While this relationship can be seen in the results, it can also be derived logically using scenario paths, market characteristics, market earnings, subsidies and capacity payments all on a country-technology specific level (Chart 30).

The CO-Firm found that a company's performance, in terms of EBITDA, is mostly driven by its current and future technology portfolio, namely its country-technology combination

Chart 30: Rationale behind the positive relationship between country-technology combinations and earnings

		 Country-specific	 Technology-specific
	Scenario pathways	✓	✓
	Market behaviour in changing surroundings	✓	✓
	Earnings from market	✓	✓
	Earnings outside market (subsidies and capacity)	✓	✓

Source: The CO-Firm

How do power market dynamics impact the country- and technology-specific earnings?

We start off by looking at the country- and technology-specific earnings in energy-only markets like the power spot market at the European Energy Exchange (EEX). Energy-only markets are mostly, directly or indirectly, based on a merit-order approach, where the available electricity supply is ranked according to short-run marginal production costs (Chart 31). The intersection with quasi-elastic electricity demand sets the market-clearing price. The price settlement is influenced by two dynamics¹:

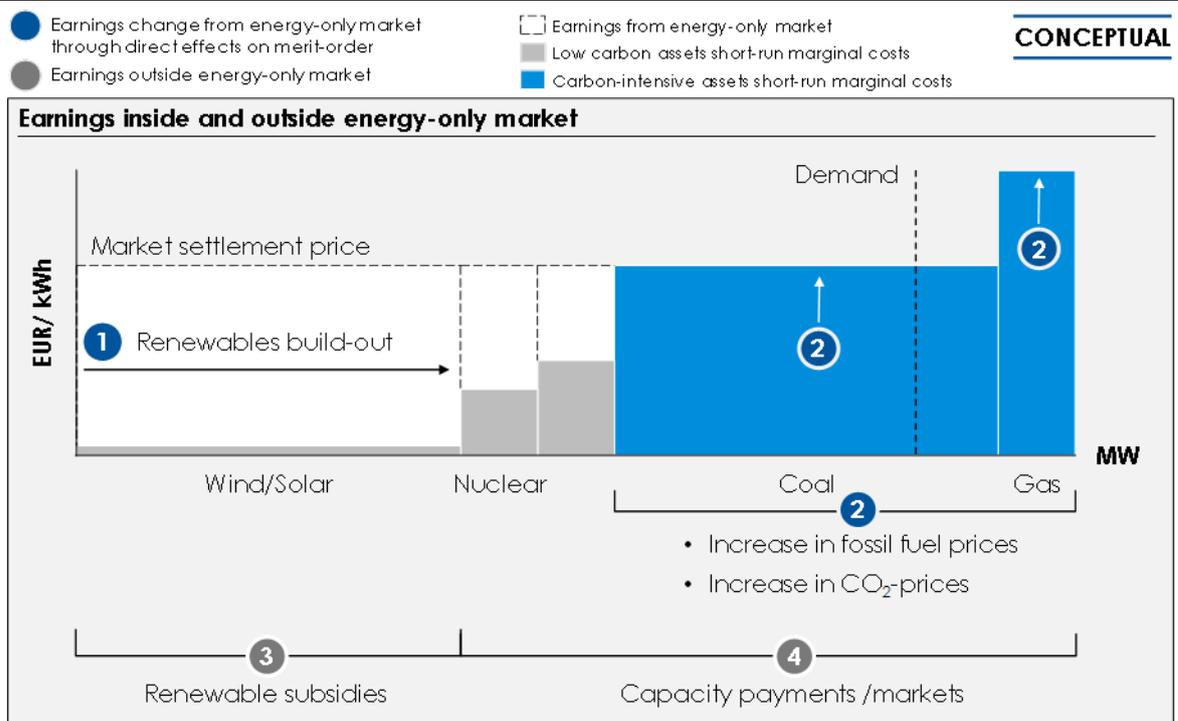
- First, country- and technology-specific scenario dynamics. Our two scenarios (LCT and ACT) include country- and technology-specific assumptions on electricity demand growth (stronger in the LCT), the build-out of renewables (stronger in the ACT), increases in CO₂ prices (stronger in the ACT) and fossil fuel prices (stronger in LCT). They also include a scenario for renewable subsidies and capacity payments to support the required developments while stabilising markets. These dynamics result in price and/ or volume effects. Due to their significantly lower marginal costs, renewable build-outs “pushes” conventional electricity generating technologies further down the merit-order. This effect is commonly referred to as the “merit-order effect”. Results are lower prices and earnings for all market participants as well as lower volumes for high-cost technologies with the same level of demand. Increasing CO₂ prices can have an opposite effect. In this case, short-run costs of carbon-intensive technologies increase, which can result in higher market

¹ For readability reasons, this text assumes that an energy market is always congruent within a country and thus both words are used synonymously. In reality, however, energy markets can be a subset (e.g. the US) or a superset of a country (e.g. France and Germany).

settlement prices. This strengthens the EBITDA of all technologies allocated before fossil fuel power plants in the merit order and decreases the competitiveness of coal relative to gas, due to the lower carbon-intensity of the latter (without CCS).

- We should also include country-specific market behavior in changing surroundings. Even when assuming the same scenario parameter across all countries, the impact on technology-specific earnings can vary significantly across countries. For instance, the magnitude of the effect of higher CO₂ prices depends on the amount of time carbon-intensive technologies set the market price throughout the year. Thus, the shape of the merit-order curve depends on the country-specific technology structure, while country-specific variable production costs have an impact on technology-specific earnings.

Chart 31: Drivers for earnings of electricity generating technologies inside and outside energy-only markets



Source: The CO-Firm

These dynamics may occur in the same market, and at the same time, producing a technology-specific net impact, as illustrated in the heatmaps in this chapter.

Embedding the results within valuations

By following the six steps described on page 61, analysts can estimate the impact on revenues, costs, capex, depreciation and other business variables from different transition scenarios.

As discussed on page 21, these results can directly be used in investment decision-making. Analysts may also want to integrate them into financial valuation models.

In this section, Kepler Cheuvreux investigates whether the result of transition risk modelling can be used in bottom-up stock valuations, and if so, how?

We focus on the practical use, rather than the interpretation, of these results. For a discussion of the results, please see page 49.

What question might you want to answer?

In our view, there are two main questions that investors can ask:

- **Question 1:** *What should the target price of a company be under a defined 2°C scenario (alternative scenario)?*
- **Question 2:** *Can I use the results from question 1 to integrate the 2°C transition risk into current valuation models (baseline scenario)?*

This first question aims to analyse the gap between current valuations and what they would be under a 2°C scenario, thus informing on potential mispricing of a stock. The second uses insights from the first question to better price current stocks.

As part of our first research paper on the topic of scenario analysis, we highlighted our view that the second question is particularly hard to answer. Indeed, answering it would involve building several stories out of multiple scenarios, testing for the valuation impact of each one, assigning them a probability and deriving a probability-weighted company valuation.

Scenarios are not forecasts, and scenario builders do not assign them probabilities. In addition, there are a large number of plausible 2°C pathways and a single 2°C scenario represents only one of them. For these reason, we focus on the first question but highlight the second as an area for future research.

How to choose the baseline?

Answering the first question, ***What should the target price of a company be under a pre-defined 2°C scenario?***, yields value when it is compared to a baseline.

In the context of this study, we want to understand the potential mispricing of assets. Thus, we use consensus valuations based on Bloomberg data (what we refer to as the “interpolated consensus”) as baseline.

We focus on the following question:
What should the target price of a company be under a defined 2°C scenario (alternative scenario)?

How did we calculate our “interpolated consensus”? The baseline was derived by Kepler Cheuvreux using the Bloomberg XDCF spreadsheet tool. The tool:

- Recreates a company-level DCF model based on the average of forecasted data for key financial parameters by financial analysts. Here, we use only EBIT, capex, and depreciation, as it is only intended for comparison purposes with alternative scenarios based on The CO-Firm's model. This allows us to attribute value for a given time period, which would not be possible with reported "consensus" data that is not disaggregated and based on a mix of financial models (multiples, DCF, etc.). Consensus does not necessarily reflect long-term trends, as most valuation models do not forecast the YOY cash flow impact of potential external changes in electricity or carbon prices after five years. For a full discussion, see the *Scenario Compass* report.
- Uses a terminal growth rate of 1.8%, which is what our utilities analysts use.
- As the choice of discount rate can impact results, we decided to use our analysts' discount rate, which varies by company and is based on the WACC. We use the same company-specific discount rate across scenarios and perform sensitivity analysis (see page 53).

We thus compare what we call an “interpolated consensus” baseline to The CO-Firm's pre-defined transition scenarios (LCT and ACT).

The Limited Climate Transition (LCT) scenario outlined by The CO-Firm corresponds with the IEA's Reference Technology Perspective, which can represent a world in which countries carry out their pledges, or nationally determined contributions, leading to a 2.7° C temperature rise. In the following sections, we consider the LCT scenario as a “central” baseline that uses more specific long-term data than the “interpolated consensus” baseline.

- The difference between the “interpolated consensus” baseline and the “central” baseline (LCT) provides information on the potential mispricing gap because of the short-termism of valuation models. The difference between the “interpolated consensus” baseline and the Ambitious Climate Transition (ACT, which corresponds to the IEA's 2°C scenario) provides information on a potential mispricing gap between current consensus forecasts and company valuations in a specific 2° world. Finally, the difference between the “central” baseline (LCT scenario) and a 2°C scenario (ACT) highlights the potential mispricing if the current policy and energy trajectory shifts to one compatible with 2°C.
- When comparing the scenario-based results (ACT and LCT) and the “interpolated consensus”, we only use scenario-based data for the

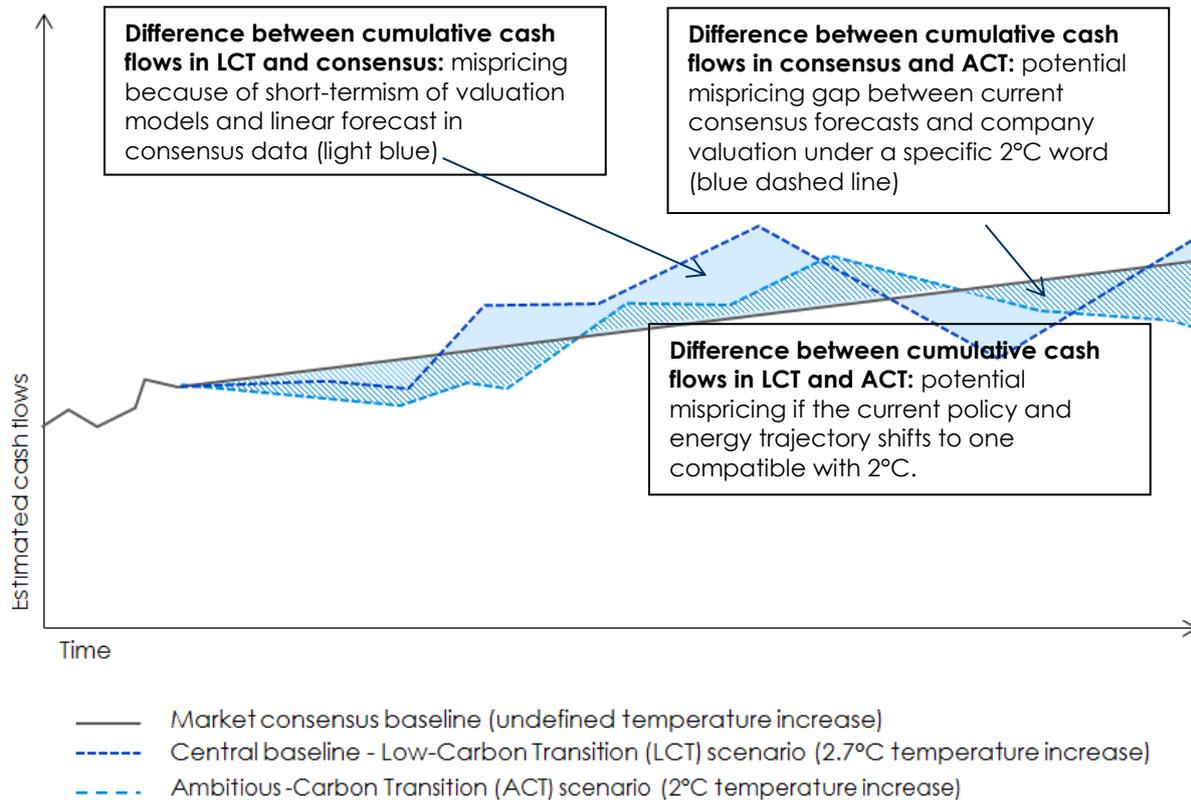
The baseline was derived by Kepler Cheuvreux using of Bloomberg XDCF spreadsheet tool for comparison purposes with alternative scenarios based on The CO-Firm's model

When comparing the scenario-based results and what we call the “interpolated consensus”, the difference can only be attributed to using specific YOY cash flow forecasts rather than an average growth figure

The difference between the “interpolated consensus” baseline and the “central” baseline provides information on the potential mispricing gap because of the short-termism of valuation models

2023-50 period (Bloomberg's "interpolated consensus" only makes cash flows granular until 2022). Therefore, the difference can only be attributed to using specific YOY cash flow forecasts rather than an average growth figure (1.8%).

Chart 32: Choosing a baseline



Source: Kepler Cheuvreux

Methodological insights: avoiding integration pitfalls

For a full description of methodological choices, see our "Investor primer to transition risk analysis" report.

The integration of transition scenario results into financial modelling can be done on both the growth potential and risk profile of specific stocks.

- The energy transition can affect the **long-term growth potential** of a specific country, sector or company. In the context of scenario analysis, analysts can either extend the period over which **specific cashflows** are modelled YOY (i.e. extend stage 1 and test for different scenarios); or change the **growth** rate used in the second-stage or the perpetuity formula (stages 2 and 3).
- Transition pathways, as captured by scenarios, can also affect the **risk profile, or variability of cashflows**, of an asset. It is worth noting that the notion of risk in finance refers to the variability from an

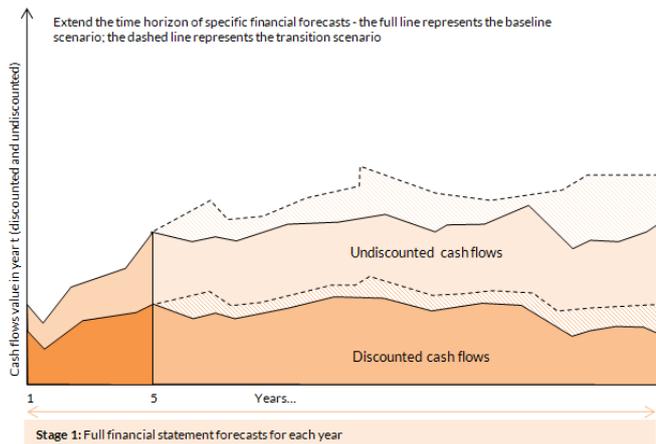
expected outcome, either positive or negative, even if in practice investors are more concerned about downside risks. This is captured in the discount rate.

The data provided by The CO-Firm model is more amenable to the first option (growth). We thus explore utilities-related methodological choices and results, before highlighting what could be done for the risk side of the story.

Modelling choice 1: YOY specific data versus the average growth rate

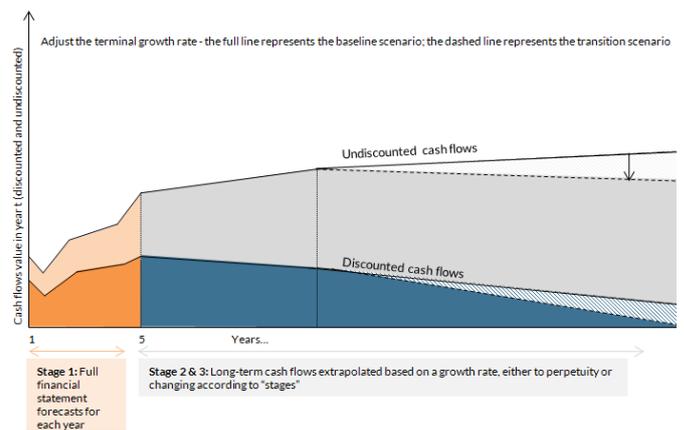
As part of our *Investor primer to transition risk analysis* report, we highlighted several potential options to use scenario data in the modelling of a specific company's growth profile for different transition paths: extend the forecasting horizon of specific cash flows or adjust the terminal growth rate.

Chart 33: Extend specific cash flows



Source: Kepler Cheuvreux

Chart 34: Adjust the stage 2 and terminal growth rate



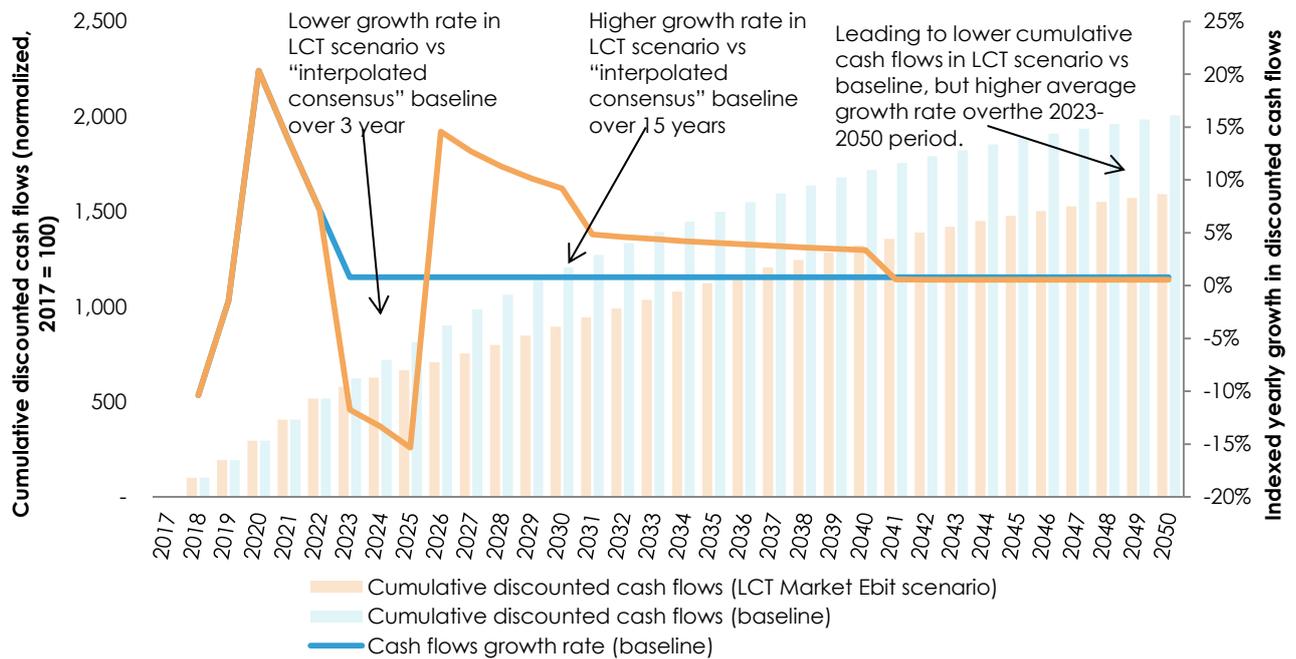
Source: Kepler Cheuvreux

For our purposes, we think that extending the specific cashflow modelling is better than changing the terminal growth rate. Indeed, the two approaches can lead to contradictory results, mainly due to discounting.

Let's take Engie as an example, under the LCT scenario, as analysed by The CO-Firm in its climateXcellence model.

- The *average yearly growth rate* in cashflows is *higher* in the LCT scenario than the “interpolated consensus” baseline.
- The *sum of the discounted cash flows* is *2% lower* in that scenario than the “interpolated consensus” baseline.
- One explanation, as illustrated in Chart 35, is that the average growth rate in the LCT scenario is lower than “interpolated consensus” over 2023-26, before growing at a faster rate thereafter. The average growth rate over 2023-50 is higher in the LCT scenario; when putting more weight on short-term differences (through discounting), the results are less favourable in the LCT scenario.

Chart 35: Avoiding methodology pitfalls - using annual growth rate versus cumulative cashflows



Source: Kepler Cheuvreux based on CO-Firm data

Modelling choice 2: time horizon

The CO-firm models company-specific EBIT, EBITDA, depreciation and capex in various scenarios from 2016 to 2050. We should therefore decide whether to use this data from 2018 or a later year, depending on our beliefs about if “interpolated consensus” takes into account shorter-term financially-relevant energy-transition risks. In addition, we should decide what data to use post-2050.

As part of this report, we decided to:

- Use EBIT, depreciation, and capex data from the “interpolated consensus” (as given by Bloomberg) for the first five years, up to 2023, reflecting our assumptions that consensus adequately reflects financially relevant shorter-term energy-transition risks. In any case, given that analysts each have their own way of modelling the first few years of cashflows, we decided to concentrate on the mid-to-long term.
- Extend the modelling of specific cash flows from 2024 to 2050, by using The CO-Firm ClimateXcellence model as explained from page 61, reflecting our view that consensus data do not adequately evaluate and price in longer-term transition risks (see below for a detailed discussion). This is also necessary to perform a scenario analysis that deviates from forecast trends (e.g. under a 2° C scenario).
- Adjust the terminal growth rate post-2050 based on the long-term terminal growth rate of our analysts, which we also use as CAGR for 2023-50 in the “interpolated consensus” scenario. Indeed, given that The CO-Firm scenario data does not go beyond 2050, we do not

want to introduce an arbitrary variable in the comparison of different scenarios.

Further area for investigation: they matter

We note two main limitations to the integration of results into company valuations:

- **Scope and calibration:** The scenario results only cover power generation activities and exclude networks, infrastructure, and gas sales. It is very hard to estimate the percentage of cash flows in any given year that comes from power generation versus other activities due to a lack of detail in financial reporting and valuation models (TCFD's recommendations might bring about a change).

Thus, we hold every other activity (e.g. networks, infrastructure, gas sales) constant in our modelling. When adding other activities, such as gas sales, the picture may be different, as they may also be affected by the energy transition and our scenarios. For gas, analysing a separate scenario might prove valuable; however, for other business units such as transmission, climate transition-related risks might be limited and thus not warrant a full scenario analysis, according to The CO-Firm.

- **Perpetuity assumption:** This analysis assumes that these companies will not cease operations, be delisted, or bought. This is due directly to how DCF models are built, but it is highly unlikely. Indeed, the average age of an S&P company was 90 years in the 1930s, 61 years in 1958, and down to 18 years in 2012 ([link](#)), mostly due to changes in size and M&A. By understanding the percentage of discounted cash flows arising from different time periods, analysts can understand the impact of different events on the total company valuation.

Impacts on the growth profiles of electric utilities

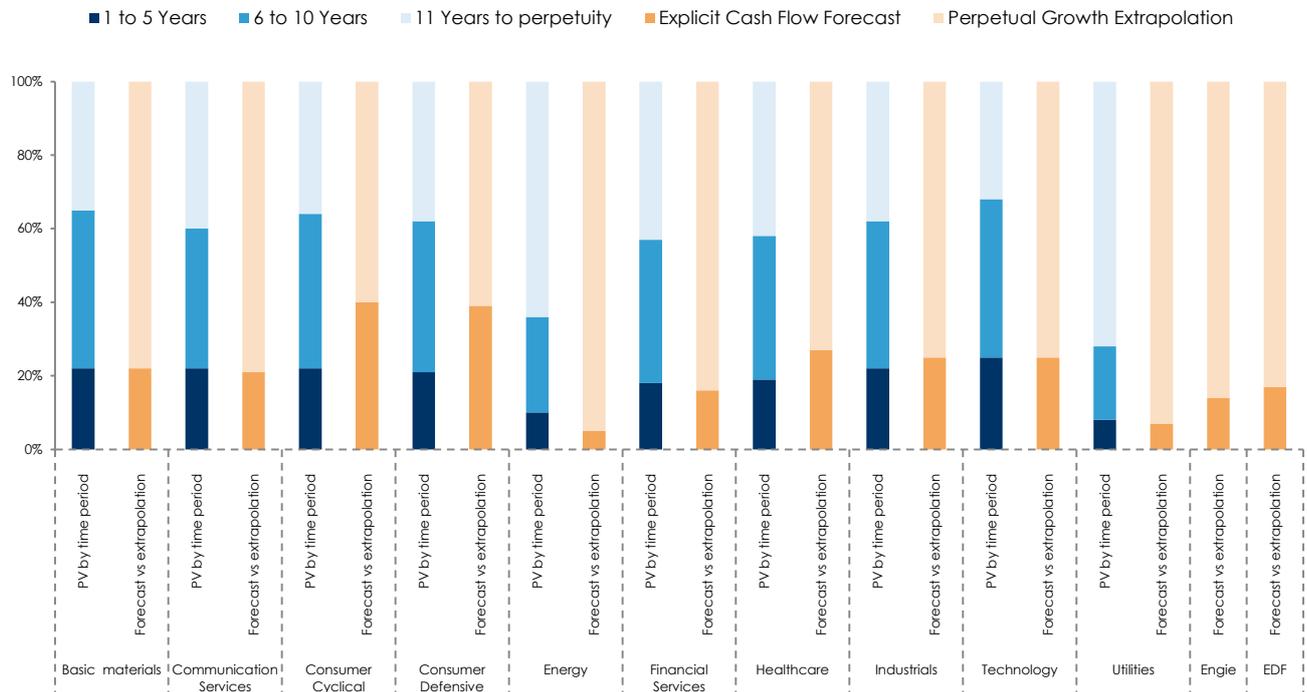
According to research by 2 Degree Investing Initiative and Generation Investment, more than 90% of company value comes from cash flows accrued more than five years in the future for the utilities sector ([link](#)). Over 60% of the net present value is from cash flows more than 20 years in the future on average, even after discounting.

Yet, these cash flows are traditionally estimated using a perpetuity formula, usually based on economic growth. This is rarely company-specific and may not take into account the impact of the energy transition on economy-wide growth.

That said, this is very important, as target prices are very sensitive to this variable. Using Bloomberg "interpolated consensus" data:

- 86% of the target price of Engie can be attributed to cash flows accrued beyond 2023; 83% for EDF and 79% for ENEL.
- A 10% change in the terminal growth rate leads to a 4% change in target prices for all three companies.

Chart 36: Divergence between actual time horizons of analysts and the materiality windows of underlying stocks



Source: 2° Investing Initiative & The Generation Foundation, 2016

In theory, the period over which the company is able to maintain a competitive advantage should be modelled YOY. The terminal growth rate reflects the average growth rate of the industry in which the company operates, or simply economic growth or inflation.

Not only could the energy transition change our industry's growth rate forecasts, but a company's positioning in a specific market or ability to adapt and maintain higher returns than its industry may also vary. In that context, can we use transition risk and opportunity analysis to derive a more specific growth profile for each company within each scenario?

Key results: the baseline is everything

We draw several conclusions when using Bloomberg "interpolated consensus" data and The CO-Firm data for scenario analysis. Please see section Scenario-based Risk Analysis: Results for a full description of the results.

As we use the same "interpolated consensus" forecasts across scenarios for 2016-23 and the post-2050 period, the difference between each scenario is attributable solely to the 2024-50 period. For the "interpolated consensus" baseline, we use a 1.8% CAGR post-2023 (what our analysts use as a terminal growth rate, as cashflows are only broken down until 2022).

We find that all else equal, both EDF and ENEL appear to be undervalued under the LCT Market scenario, while Engie appears to be overvalued. Note that this result is highly dependent on assumptions.

We find that all else equal, both EDF and ENEL appear to be undervalued under the LCT Market scenario, while Engie appears to be overvalued

- When comparing the “interpolated consensus” forecast with the LCT scenario, which represents likely policies that will be implemented on the back of the COP negotiations process, it appears that analysts do not fully price in the potential longer-term growth in the case of EDF or ENEL, while being too optimistic for Engie. We explain why that might be in Table 4.
- The differences are amplified under the 2° C scenarios. Both ENEL and Engie benefit from our pre-defined ambitious 2° C scenario (ACT) compared to the soft transition scenario (LCT). The difference between the ACT and LCT scenarios for EDF is not significant enough to allow us reach any conclusions.

The four adaptation-transition scenarios tested only represent a sample of the multiple possible futures and pathways

It is important to understand that the four adaptation-transition scenarios tested only represent a sample of the multiple possible futures and pathways, both in terms of company strategy (e.g. asset base and geographical spread) and external evolutions (e.g. in electricity prices, carbon prices, etc.). Therefore, they only represent one potential plausible future, without any probability attached to it.

Table 4: CAGR 2023-50E under different scenarios

“Interpolated consensus”		LCT		ACT	
		Market	Market EBIT	Market	Market EBIT
EDF	1.8% CAGR	c. 3% CAGR	c. 3% CAGR	3% CAGR	2% CAGR
<p>EDF is affected positively by rising CO2 prices post-2023 because of its large exposure to nuclear and water generation assets – although it is relatively less sensitive to changes in CO2 prices than other companies, due to its regional footprint (mostly France, see below). The higher growth rate under the LCT scenario compared to “interpolated consensus” can be attributed to rising CO2 prices and renewable exposure post-2023.</p> <p>The differences are amplified under the ACT (2° C) scenarios. EDF would not significantly benefit more from our pre-defined ambitious 2° C scenario compared to the soft transition scenario, as gas and nuclear assets in France are relatively less sensitive to changes to CO2 price levels. The difference in cash flows between the LCT and ACT scenarios for EDF is not significantly different. EDF has relatively lower flexibility due to its strong exposure to nuclear – therefore, under the “Market EBIT” scenario, the results are not significantly different from the “market” scenario for the LCT and ACT scenarios.</p> <p>With its newly-announced solar plan of EUR25bn, EDF may increase its sensitivity to CO2 prices and therefore better benefit from a 2° C scenario over the long-term.</p>					
Engie	1.8% CAGR	1% CAGR	2% CAGR	1% CAGR	2% CAGR
<p>Even if the 2% growth in the Market EBIT LCT scenario is higher than the 1.8% used in the “interpolated consensus” forecast, the overall sum of the discounted cash flows is lower than consensus, due to modelled decreasing cash flows in 2023-26. This is primarily driven by the mid-term drop in gas generation asset revenues that do not benefit from CO2 price growth in regions with no significant coal exposure (e.g. France) and are therefore at the edge of the merit order. After 2025, capacity payments compensate for the relative loss and cash flows increase thereafter.</p> <p>This is not captured in current consensus forecasts, in our view, as post 2023 is modelled using an average growth rate rather than specific forecasts. The differences are amplified under the 2° C scenario.</p>					
ENEL	1.8% CAGR	c. 2% CAGR	6% CAGR	3% CAGR	10% CAGR
<p>While ENEL also experiences a decrease in cashflows over 2023-26 for the same reason as Engie, its exposure to renewables in emerging countries offsets the decrease in revenues of its gas assets over 2023-26.</p> <p>The differences are amplified under the ACT (2° C) scenarios. ENEL would significantly benefit from our ambitious 2° C scenario if it is able to adapt and increase its market share (ACT market-EBIT scenario). This is largely attributable to the significant increase in renewable generation capacity as per The CO-Firm modelled data.</p> <p>In our view, ENEL is the most agile company, and according to The CO-Firm’s modelling. Therefore, we observe a large difference between the “market” and “market EBIT” scenarios, both for the LCT and ACT.</p>					

Source: Kepler Cheuvreux, based on The CO-Firm data. For a full discussion of the results, see page 22.

Chart 37: While Engie would benefit from a 2° C scenario (ACT) compared to the low-transition scenario (LCT), it appears to be overvalued in three of the six alternative scenarios, based on “interpolated consensus” and The CO-Firm data.

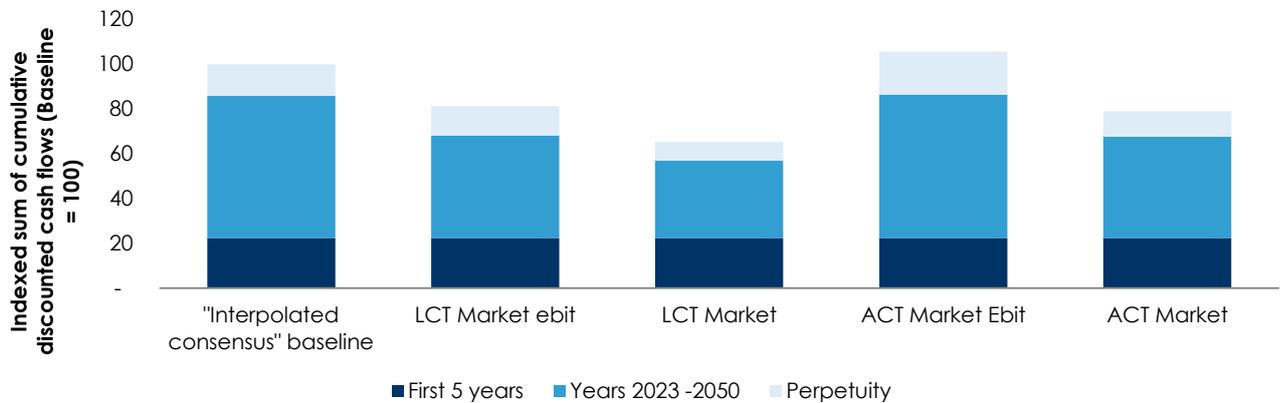


Chart 38: ENEL would benefit from both transition scenarios, especially under the “Market EBIT” adaptation scenario; it appears to be undervalued in all four alternative scenarios, based on “interpolated consensus” and The CO-Firm data.

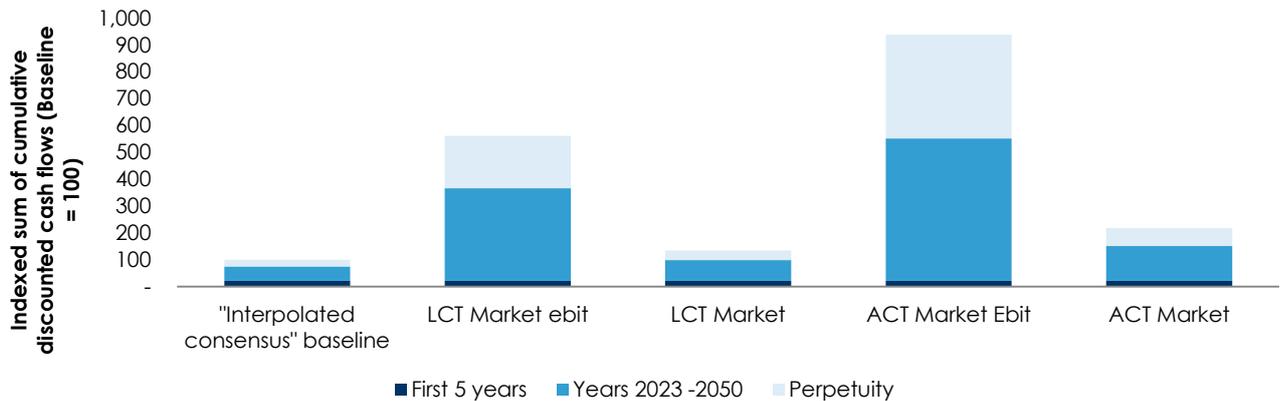
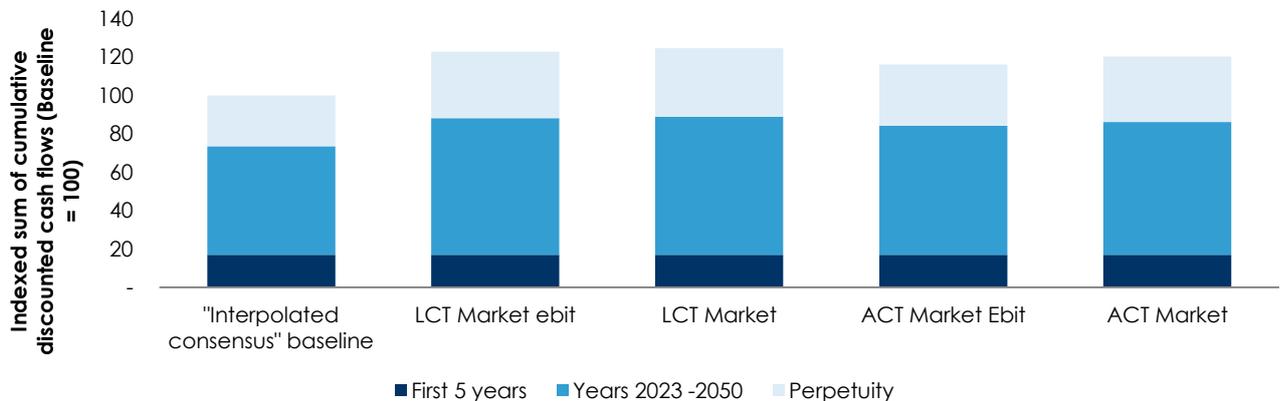


Chart 39: EDF would slightly benefit more under most of the low versus the ambitious transition scenario. It appears to be undervalued in all four alternative scenarios, based on “interpolated consensus” and The CO-Firm data.



Source: Kepler Cheuvreux, based on The CO-Firm data

A significant caveat associated with these results is a result of the limitation highlighted on page 66 and the fact that they represent only alternative views of the future, without any probability attached. Indeed, the 2° C

target can be achieved through a variety of pathways, and our scenarios represent only one.

In addition, our results depend on the terminal growth rate used in the baseline as well as the discount rate. Based on the sensitivity tables below, we show that under the “ACT market EBIT” scenario, most of the time the results are higher than the baseline.

Table 5: Engie % difference between baseline and ACT Market EBIT scenario – sensitivity analysis

Discount rate/ long-term growth rate	0.80%	1.30%	1.80%	2.30%	2.80%
5.34%	-17%	-22%	-28%	-33%	-39%
5.84%	-18%	-23%	-28%	-33%	-38%
6.30%	-18%	-23%	-28%	-32%	-37%
6.84%	-19%	-23%	-27%	-32%	-37%
7.34%	-19%	-23%	-27%	-31%	-36%

Table 6: ENEL % difference between baseline and ACT Market EBIT scenario – sensitivity analysis

Discount rate/ long-term growth rate	0.80%	1.30%	1.80%	2.30%	2.80%
4.8%	1043%	977%	912%	851%	792%
5.3%	1026%	961%	900%	840%	783%
5.8%	1008%	946%	887%	830%	775%
6.3%	991%	931%	874%	819%	766%
6.8%	974%	917%	862%	809%	757%

Table 7: EDF % difference between baseline and ACT Market EBIT scenario – sensitivity analysis

Discount rate/ long-term growth rate	0.8%	1.3%	1.8%	2.3%	2.8%
4.84%	35%	26%	17%	8%	-2%
5.34%	33%	25%	17%	8%	-1%
5.84%	31%	24%	16%	8%	0%
6.34%	30%	23%	16%	8%	0%
6.84%	29%	22%	15%	8%	1%

Source: Kepler Cheuvreux

Impact on electric utilities' risk profiles

The climate and energy transition could not only affect the companies' growth profiles, but also the riskiness of their cash flows, i.e. the likelihood that investors receive a return that is different from what is expected. As this is usually captured through the discount rate, how could we adjust the discount rate in the context of scenario analysis work?

We note that the net present value of companies is particularly sensitive to the discount rate, thus care needs to be taken when trying to adjust it. For example, ±10% WACC leads to a ±12-10% change in the net present value of discounted cash flows for ENEL, Engie, and EDF.

There are two sides to the equation if we use the Capital Asset Pricing Model (CAPM): the equity risk premium and the beta. One can also directly change the cost of equity, or even the discount rate, without focussing on individual underlying variables.

How can we adjust the discount rate in the context of scenario analyses?

How we modify the discount rate and through what variable depends on the story we want to tell, i.e. whether we want to investigate the historical sensitivity of companies' share prices to transition-related shocks, or how this sensitivity is changing as their strategy and exposure evolve.

Chart 40: Calculating the discount rate using CAPM

CAPM formula

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f]$$

E(R_i) = cost of equity

R_f = risk-free rate

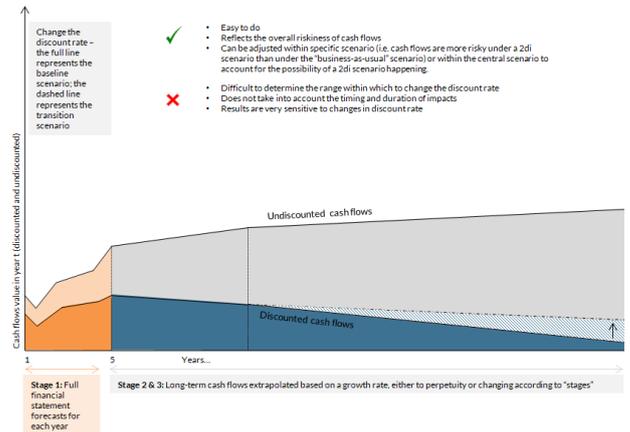
β_i = beta of asset I; a measure of systematic risk

E(R_m) = Return on equity

[E(R_m) - R_f] = Equity market risk premium, a measure of the excess return of the market portfolio over the risk-free rate

E(R_i) feeds into the "weighted average cost of capital", used as the **discount rate** in DCF models.

Chart 41: Adjusting the discount rate



Source: Kepler Cheuvreux

Source: Kepler Cheuvreux

How sensitive have these companies historically been?

As discussed in our *Investor primer to transition risk analysis* report, the academic literature has historically focussed on how to adjust the discount rate in *current* valuation models, based on the historical relationship between returns and specific variables, most often carbon emissions but also fuel prices and electricity consumption in the context of electric utilities.

- For example, collecting data from April 2005 to December 2011 for 23 European utilities, Massari et al. (2016) identified a statistically relevant carbon beta of 0.03 for high emitters (>500 kg CO₂/MWh) and 0.06 for low emitters (<300 kg CO₂/MWh).
- We note that these estimates are not aligned with previous research from Koch and Bassen (2013), which found statistically relevant results only for high-emitting companies (>200 kg CO₂/MWh) but not for low-emitting companies (<100 kg/MWh). In particular, the results were not statistically significant for EDF, ENEL, or Engie.

Most transition risks are emerging and have not historically been fully priced in by the market, thereby limiting the usability of time-series analysis. Moreover, these analyses are not based on scenarios, but single factors. In addition, this type of analysis, while useful, is mostly based on historical data which may not reflect the *future sensitivity* of stocks' returns to specific variables. Indeed, stocks' sensitivity to transition-related risks may evolve as companies change their strategy and asset base.

Embedding the results of scenario analysis in the discount rate

We derive the implied discount rate for each scenario that answers the question: what is the implied discount rate that we would need to apply to

our consensus baseline cash flow model to match the company valuation under each alternative scenario?

This therefore gives the risk premium/discount attributable to each scenario and yields the same results as the analysis on page 22. Certain investors may then use that adjusted discount rate in their base case to model the impact of the energy transition on valuation. This approach should not be used together with cash flow adjustments, as it could lead to double-counting. In other words, this differs from "subjective" adjustments that may be seen in the market.

Table 8: Implied discount rate under each scenario

	ENEL	EDF	Engie
Baseline	5.80%	5.84%	6.34%
ACT Market	1.14%	4.36%	8.45%
ACT market EBIT	No solution - % change very high	4.20%	6.51%
ACT 2020	5.53%	6.23%	9.67%
LCT market	3.85%	4.15%	9.97%
LCT market EBIT	No solution -% change very high	4.20%	8.38%
LCT 2020	6.97%	6.02%	10.87%

Source: Kepler Cheuvreux, based on The CO-Firm data

Given that The CO-Firm models different adaptive pathways (and associated asset base) for each company as part of the LCT and ACT scenario, the changing sensitivity of companies' cashflows to external transition risks is embedded in the results. However, while prospective by nature, this approach limits the results to a set of scenarios and does not capture the changing sensitivity of cash flows to transition-related risks.

This is particularly important, as research by Cired shows that investments in energy assets (fossil-fuel based; renewables) are sensitive to macroeconomic changes under a 2° C scenario. Indeed, there is a range of oil prices and GDP levels that are compatible with a 2° C scenario and could lead to different investments levels, all compatible with that scenario.

The IPCC has also highlighted the range of carbon prices compatible with a 2° C scenario in its Mitigation report ([link](#)). Our scenarios, as built, only take into account one possibility. Therefore, as a next step, we analyse the sensitivity of cash flows to changing external parameters under each scenario.

Changing sensitivities to energy-transition risks over time

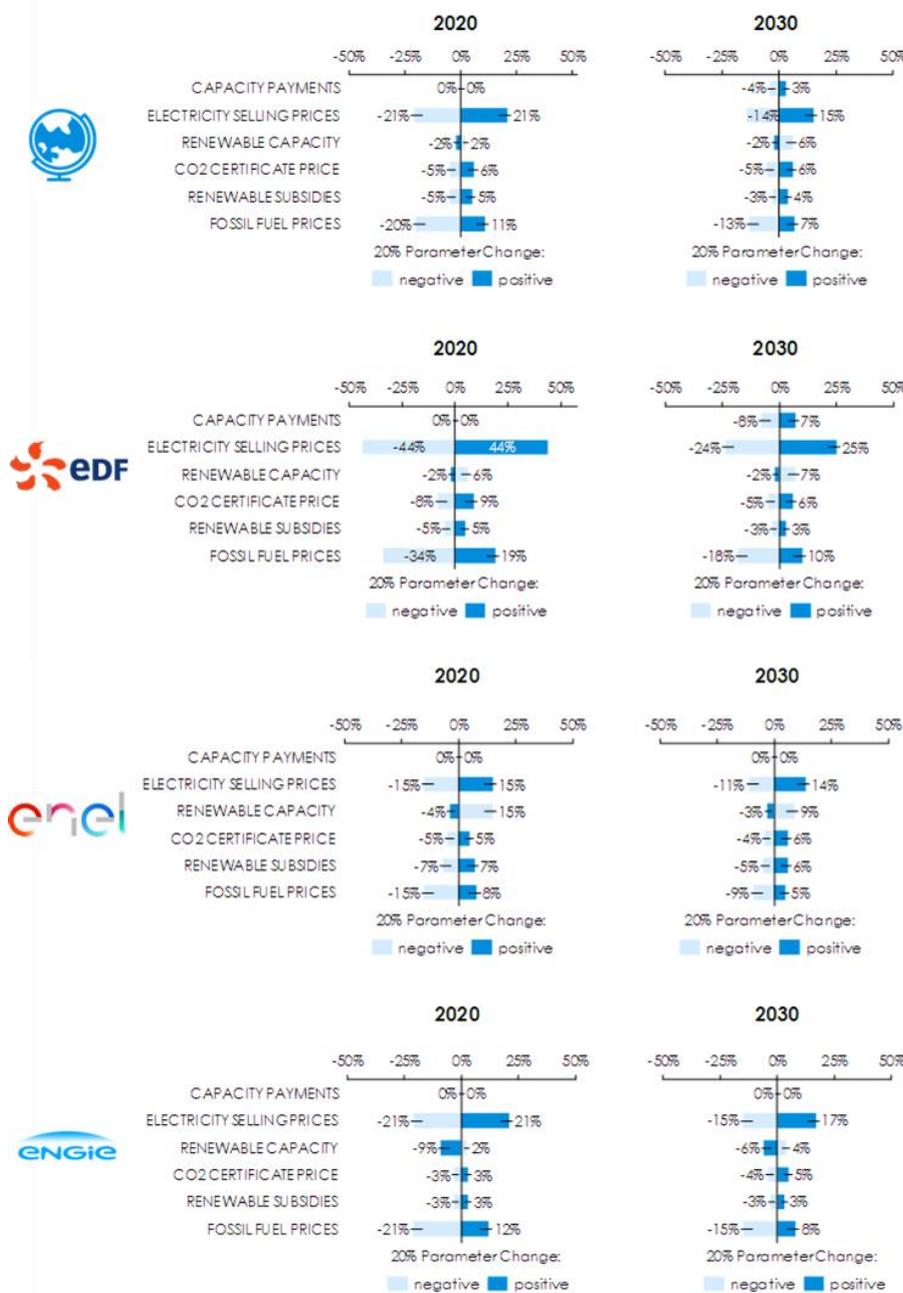
Research by Carbon Tracker Initiative provides a good example of this concept in the context of Oil & Gas companies. They find that a 2° C compatible oil & gas asset portfolio is less sensitive to the changes in oil prices that could arise under a 2° C scenario than a business-as-usual portfolio. Therefore, it warrants a lower beta than the baseline ([link](#)).

As explained by The CO-Firm on page 22, the EBITDA sensitivity profile of EDF, ENEL, and Engie changes over 2020-40. For example, we see a lower

sensitivity in 2040 to electricity demand and fuel prices across the board. EDF's EBITDA sensitivity to carbon prices decreases, while that of Engie increases, as their sensitivities depend on their geographical footprints and technology mixes.

Given that EBITDA is the largest single value driver in our cash flow calculations, this means that all company valuations become relatively less sensitive to transition-related risks as they adapt their asset base, thus potentially warranting a decreasing discount rate. Out of our sample, EDF remains the most sensitive, compared to Engie and ENEL.

Chart 42: Changing EBITDA sensitivity profile over time



Source: The CO-Firm

Analyst guidance: The results and charts above exclusively highlight findings from a climate risk scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (grid-connected electricity generation only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: Frozen, Market, Market EBIT, in current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2020 are based on Platt's World Electric Power Plant database from June 2017. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

Going further: capturing the overall adaptive capacity

The results presented in Tables 5, 6, and 7 assume a limited number of adaptive pathways for each company based on outlined scenarios.

- For example, the "Market EBIT" scenario assumes that companies with profitable country/technology asset mix and higher earnings have greater abilities to apply risk mitigation strategies and invest in new technologies.
- These adjustments therefore only partly take into account the multiple facets of adaptive capacity, such as governance, culture, and strategy. Would taking these into account significantly change our view of the company?

Senior ESG Analyst Samuel Mary lays out our bottom-up assessment framework and classification of criteria that can shed light on utilities' "theoretical" long-term adaptive capacity to transition risks and opportunities linked to an acceleration of the energy transition (policies and market shifts, etc.).

The fundamental objective is to compare individual companies' velocity and alignment with the main characteristics of this sector transformation to peers. This includes: decentralisation compounded by digitalisation and the rise of storage; and "new" energy (grid, retail, and renewables) gaining ground, versus "old" (conventional generation, supply & trading, gas midstream) energy.

As a high-level assessment, we see ENEL as the most agile, followed by Engie then EDF. This view is also aligned with the view of our equity analysts. Therefore, the ClimateXcellence results are in line and do not come as much of surprise. However, it is interesting to see the magnitude of the difference between each company and have specific numbers as a starting point for discussion.

Bottom-up assessment framework and classification of criteria that can shed light on utilities "theoretical" long-term adaptive capacity

Table 9: Tentative multi-criteria adaptive capacity assessment (illustrative, not exhaustive)

Criteria	Company	Theme	Estimated impact on adaptive capacity	Description
Strength of the balance sheet and Tangible asset				
Debt	EDF	Nuclear asset base	Negative	Less capital flexibility than peers in part due to a high economic net debt/EBITDA (5.1x in 2016)
Tangible assets				
Capacity	ENEL	Ownership structure, scale, average age, efficiency, forecasts based on assets lifespan, planned retirements	Positive	Global, diversified, flexible and efficient generation fleet, lower conventional generation
Intangible assets				
Intellectual Capital (Innovation/R&D)	EDF	Risks management	Positive	The Climate services Department develops methods, models and sophisticated databases tools with "ready-to-use" climate projections for different lines of business
Human capital	EDF	Skills/Appropriate staff talent attraction and retention	Negative	Strong nuclear legacy
Intellectual Capital (Innovation/R&D)	ENEL	Innovation	Positive	Open Power (customers, technologies) strategic stance to support the business plan, including the smart meters rollout, based on telecom carrier contracts (rented infrastructure) and electric mobility. The goal is to foster a culture of flexibility and agility among its shrinking staff (internal assessments).
P&L				
Revenues, earnings and cash flows	ENEL	Business model, product and geographical diversity	Positive	More than half of its EV comes from regulated businesses, which offer high visibility, while 27% is semi-regulated and only 20% has merchant exposure (our calculations). 90% of the EBITDA is already regulated or contracted; and >80% is from a low carbon mix. Focus on 1) contracted power (mainly renewables); 2) networks; and 3) customer solutions i.e. renewables, services, contracted power markets and networks, to the detriment of its merchant and coal-fired exposure. Acquisition of Solairedirect, a pure play on the fast-growing solar-PV market, and a few acquisitions of energy services providers in Europe (the UK, Germany and Poland), the Americas (the US, Brazil and Chile) and Asia (Singapore, Australia and Qatar).
	Engie		Positive	
Costs	Engie	Opex	Positive	An opex reduction target of EUR1.2bn by 2018, via headcount reduction at the headquarters, real estate rationalisation, cuts in consulting, operational efficiency (e.g. predictive maintenance), centralised procurement via a shared services centre, etc. The organisation is thus set to be more efficient and leaner; 60% of the 2018 savings goal has been achieved.
	ENEL		Positive	
Capital allocation: investments	EDF	Nuclear asset base	Negative	Low share of capex allocated to growth activities. The target is to increase renewable capacity to 50GW in 2030 from 29GW in 2016 (tiny share of overall generation)
	Engie	Low-carbon shift	Positive	1) Asset portfolio rotation, including EUR15bn in divestments and EUR14bn in growth capex (ex-E&P), with a focus on low carbon energy mix (>90% of EBITDA), integrated customer solutions (EBITDA to grow by 50% or EUR1bn, from c. EUR1.9bn in 2016) and regulated/contracted activities (>85% of EBITDA); 2) Increased investment in emerging technologies (EUR1bn of the growth capex figure will be dedicated to digital and innovation). While Engie's massive divestment programme raises lots of question on the reallocation of the proceeds, we would rule out a scenario of big transformational M&A.

Governance				
Board	EDF, Engie	Expertise, quality and oversight	Positive	Proportion of board members with identified climate expertise above 10%
Shareholding structure	EDF	State influence	Negative	Strong nuclear legacy, and short-term considerations
Strategy				
Portfolio test	ENEL	Scenario analysis	Positive	Long-term forecast of the main variables involved in the business development and investment valuation processes. 50-year forecast on countries with presence and investment interest
Alignment with structural trends	EDF	Shift from centralised to distributed generation, Digitalisation, Energy efficiency and storage	Positive	Assessment of the resilience of the projects to different CO2 prices
	ENEL		Positive	Leadership in smart meters rollout (66%). Increased support to more ambitious low carbon policies. Greater focus on digitalisation and technology
Disclosure of metrics and targets				
Various climate-related KPIs	ENEL	Comprehensive carbon reporting and target	Positive	Only utility among the three with a science-based, carbon-neutral target

Source: Kepler Cheuvreux

Going further: Linking earnings surprise and price shocks

Historically, certain share price movements can be linked to transition-related themes. For example, the lack of visibility on French energy policy has been the main reason for EDF's share price volatility in recent years. For Engie, the strategic shift and good execution on the transformation have been the drivers for the share price rerating recently. The transition of ENEL's strategy towards a more regulated and more renewable asset base is the main driver behind the stock's performance in the last three years, according to our analysts.

One of the potential uses of scenario analysis is to identify early market signals that could lead to a change in share price if some energy transition consequences come as a surprise. An earnings surprise, for example triggered by unexpected revenue, cost, or capex changes, need not translate into abrupt shifts in share prices.

Understanding the sensitivity of market returns to earnings surprise *in general* could therefore help us get a sense of the potential magnitude of a *transition-related* earnings surprise at a point in time *t*.

- This approach has the advantage of taking the net effects of all scenario parameters and capturing the potential surprise effect.
- However, the market return sensitivity is not specific to transition risks and opportunities.
- Because they are based on historical data, the results are backward-looking rather than forward-looking.

There is a large body of literature on earnings surprises and share price reactions. We do not attempt to build a comprehensive model here or to advance this debate, but rather we want to show how this thinking could be applied to a specific sector within transition scenario analysis. Thus, we look both at positive and negative earnings surprises.

Using Factset data, we calculated the price reaction and excess return of each company versus the Stoxx Europe 600 Utilities to an earnings surprise, using a sample of six companies' quarterly announcements (Fortum, RWE, Verbund, ENEL, Engie, and EDF) from 2008 to 2017. We define an earnings surprise as the deviation (regardless of the magnitude) of announcements from consensus – the deviation need not be attributable to the energy transition.

Findings 1: Excess returns tend to move in the same direction as earnings surprises, hinting at a positive correlation. The correlation coefficient is not very high, with earnings surprises explaining 6% of the movement (slope = 0.10) on average over our full sample. In some cases, excess returns moved in the opposite direction to the surprise. This can be due to the fact that:

- The data that we use to estimate earnings surprise is only a proxy for the "surprise".

Certain share price movements can be linked to transition-related themes

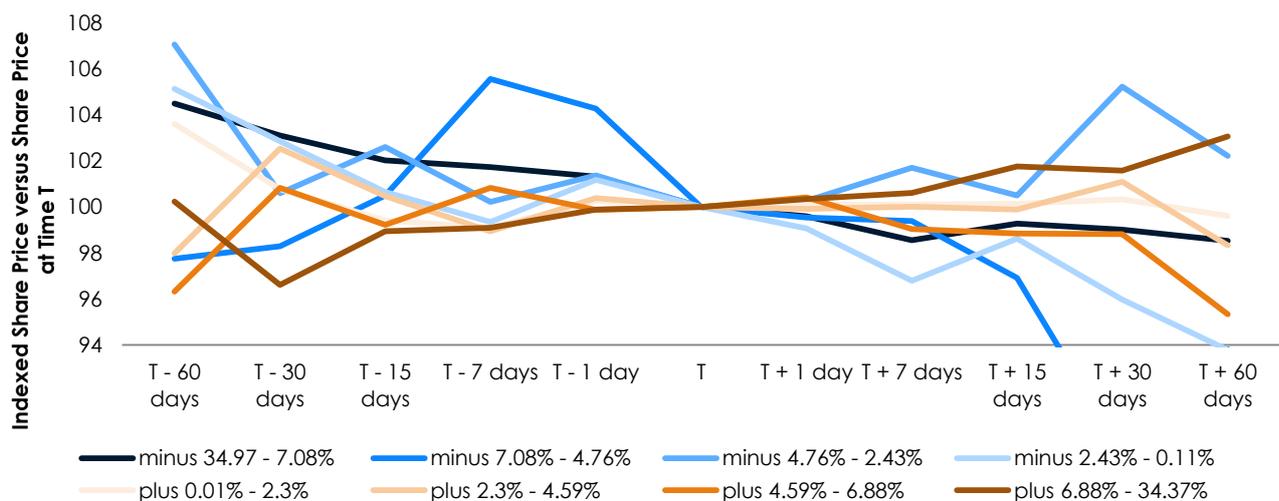
One potential use of scenario analysis is to identify early market signals that could lead to a change in share prices if some energy transition results come as a surprise

- Earnings announcements contain more information than just the surprise, such as a general outlook for the business.
- As long as the fundamentals remain strong, an earnings surprise may not lead to increased movements in the markets depending on the shareholding structure of the company (e.g. companies with larger market caps will tend to have a larger institutional shareholder structure that will lead to short-term trading and price movements on the back of a surprise).

Findings 2: We observe a drifting pattern before and after earnings announcements – in some instances, share prices have already started to drift before the announcement and continue to do so afterwards. Studies disagree on the exact timeline ($\pm 7, 30, 60$ days). We show what this looks like in our sample (restricted to announcement events where earnings consensus had a standard deviation of under 0.15) by splitting earnings surprises into four buckets. We also observe an asymmetry in sensitivity, with excess returns more sensitive to negative than positive surprises.

We observe a drifting pattern before and after earnings announcements

Chart 43: The “drifting” phenomenon



Source: Kepler Cheuvreux

Findings 3: We observe that on a company level, the picture can differ quite substantially. EDF for example exhibits a larger-than-average sensitivity of excess returns to earnings surprises on the day ($R^2 = 0.27$, slope = 0.39), while the larger impact on Engie and ENEL show insignificant sensitivity.

We find that the share prices in the utilities sector have not been historically strongly correlated with earnings surprises (correlation of +0.15). This could be due to the fact that share prices also move based on the narrative, rather than pure numbers, hence the importance of qualitative information as much as data in the context of scenario analysis. It is therefore necessary to closely monitor how companies are transforming, how they

are communicating, and whether the information they provide is relevant in the face of the transition. Our company profiles on pages 8-12 provide engagement questions for each company.

The next steps when integrating the results into baseline valuations

This paper explores how to use the data derived by The CO-Firm within a limited set of predefined scenarios. This is useful in understanding what parameters drive company valuations and could be affected by climate change, as well as identifying the different quantitative integration options that an analyst has when performing such an analysis.

However, in order to drive capital allocation, analysts need to make a judgment on the probability of such scenarios. As mentioned, there is a large number of plausible scenarios and pathways, and deriving probability weightings that are not subjective is quite difficult. One therefore has the option of accepting this subjectivity or performing more sophisticated analysis.

An option which in our view could be interesting to investigate as a future area of research is to derive a probability distribution and plausible ranges for each of the key parameters that could be affected by transition scenarios (here, carbon prices, electricity prices, etc.) and perform a Monte Carlo analysis (generating random variables for modelling risk). This would allow analysts to understand under which conditions company valuations would beat consensus.

An option which, in our view, could be interesting to investigate as a future area of research is to derive a probability distribution and plausible ranges for each of the key parameters that could be affected by transition scenarios

Appendix: ClimateXcellence model

This section builds on:

- Validation with a broad range of financial and ESG analysts, academia, and practitioners over the last five years.
- Model co-development and extensions with Allianz Global Investors, Allianz Climate Solutions, WWF Germany, and the Investment Leaders Group hosted by the University of Cambridge.

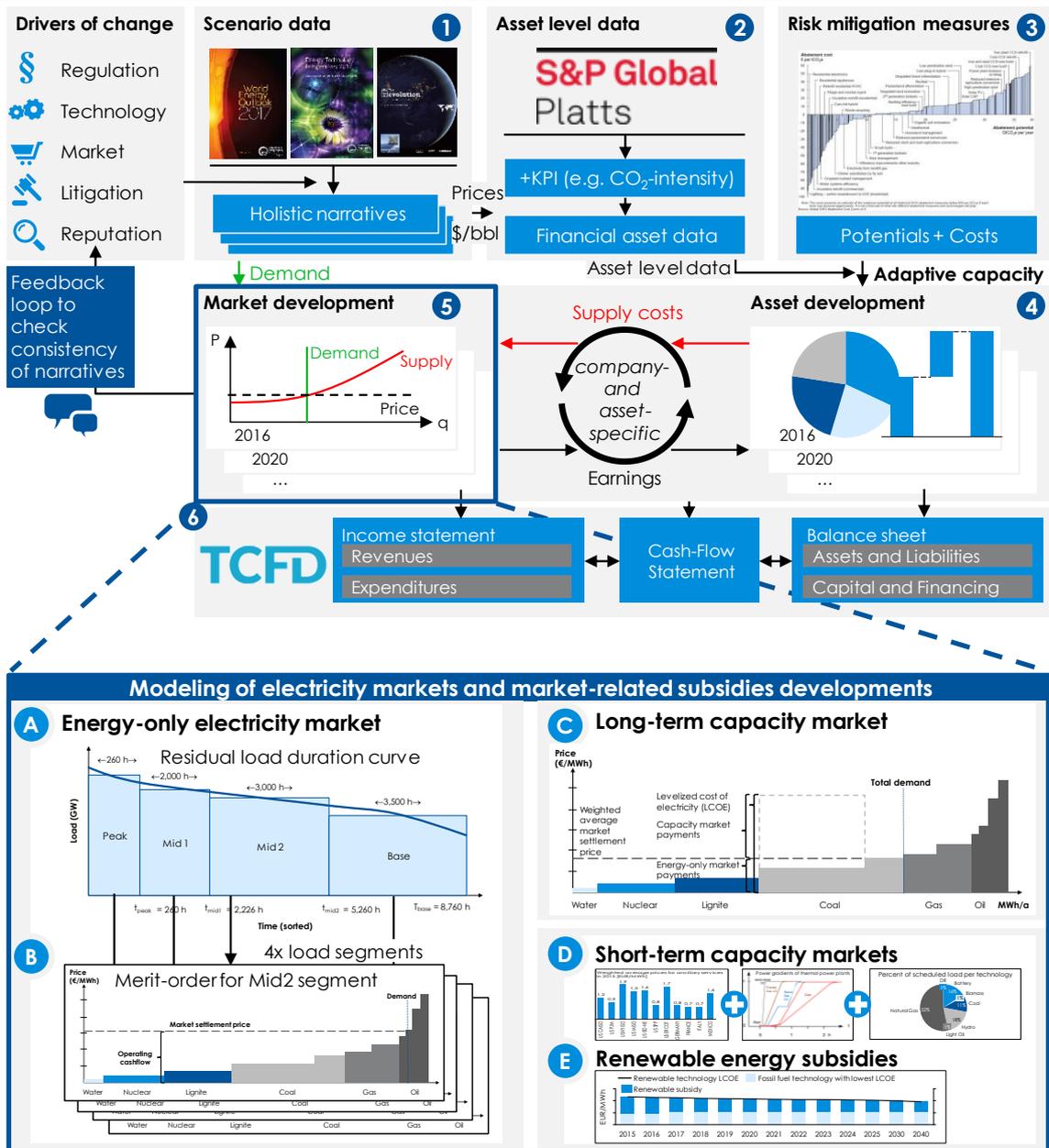
Research is published in the following documents:

- *Feeling the heat*, CISL, and CO-Firm (2016, [link](#)).
- *Transition scenarios: the transition risk-o-meter. reference scenarios for financial analysis* (2dii, The CO-Firm, June 2017, [link](#)).
- *Adaptive capacity: changing colors. Adaptive capacity of companies in the context of the transition to a low carbon economy* (2dii, The CO-Firm, Allianz, Allianz Global Investors, August 2017, [link](#)).

This section illustrates the practical application of the *Investor primer to transition risk analysis* published by Kepler Cheuvreux and The CO-Firm ([link](#)), which provides a higher-level discussion of the concepts and analysis steps described below.

Overview of the ClimateXcellence model

Chart 44: Overview of the method applied. How to derive the business impact of transition scenarios in the power sector



Source: The CO-Firm

Financial modeling of the utilities sector with respect to climate scenario analysis can be divided into six central steps (Chart 44; subsequent numbering is consistent with the chart; for more general information on each of the following steps, please refer to the "Investor primer to transition risk analysis" report for more details).

Financial modeling of the utilities sector only analyses financial impacts from electricity generation. Other typical revenue streams (e.g. transmission or energy trading) were excluded from the analysis, as they are

substantially less material with respect to climate change and energy transition impacts.

1. **Derive the key risk drivers to translate a scenario into a narrative.**

First, develop a holistic transition narrative by extending scenario data with consistent transition drivers. For utilities, we conducted the following steps to derive a consistent scenario:

- a. Breaking down country-specific technology pathways (wind, coal, solar, etc.) by region and country based on IEA ETP data.
- b. Deriving information on regulatory interventions (e.g. CO₂ prices and subsidies) by region and by scenario based on current and announced regulatory regime, climate targets, envisaged technology pathways (see point a), etc.
- c. Extrapolation of input energy prices by scenario and by region based on IEA data.
- d. Analysing, extrapolating, and breaking down country-specific electricity demand by scenario from IEA data based on assumptions about population and GDP growth, energy efficiency, and others.

2. **Build a technology database with financial information on individual technology.**

Since climate transition impacts technologies differently (even within the same sector), building a financially meaningful technology database is central to the modeling. For the modeling of the utilities sector, we build a separate technology model based on S&P's *World electric power plant database* from June 2017. The database contains information such as type of technology (wind, coal, gas), installed capacity, ownership structure, start-up year, location, etc. We have complemented the available data (technology-specific) with the following information:

- a. Generation efficiency over time.
- b. Capex/opex over time by scenario and by region.
- c. Status of depreciation and expected year of decommissioning based on the age of the plant.
- d. Fuel consumption, CO₂ intensity, marginal short-run electricity production costs, and levelised costs of electricity.

3. **Conduct a techno-economic assessment of risk mitigation measures (“adaptive capacity”).**

Financial modeling of climate risk must consider companies' ability to anticipate transition risks and develop mitigation strategies. With respect to the utilities sector, analysing risk mitigation has to take into account a variety of aspects such as:

- a. The scenario applied (e.g. ACT, LCT).
- b. The current technology base of a company, e.g. type, location, and age of technologies.
- c. Technology costs.

d. The risk-return profile of the market (including fuel prices, subsidies, spot market electricity prices, and capacity payments).

4. **Forecast companies' technology development with and without adaptive capacities under different scenarios.** The development of companies' technology databases is basically a function of demand development (see point 1), the company's current technologies (see point 2) and its adaptive capacity (see point 3). For the utilities sector, we modelled three individual technology development pathways: frozen, market, and market EBIT (see section 4 for a detailed description of adaptive scenarios).

Entry into markets in which utilities companies are currently not operating is not modelled. To make data for development of companies' new investment until 2020 more reliable, we take into account new projects in S&P's *World electric power plants database* from June 2017. Here, we rely on S&P's research methodology, where key determinants in approximate order of importance for new company investments are (see S&P's WEPP database description and methodology) as follows:

- a. Order placement for generating equipment or EPC services.
- b. The status of licensing or permitting activities.
- c. Funding.
- d. The availability of fuel and/or transmission access.

5. **Forecast market development based on the demand and supply developments to derive prices and revenues in the scenarios.** With the market forecast, the consistency of drivers and scenarios (see point 1) can be validated. In the case of utilities, we analysed and modelled country-specific power markets, which included:

- a. **Merit-order-based spot markets:** The merit order is a ranking of the sources of electricity generation in a given power market, based on ascending marginal costs of production (excluding the capital expenditure involved). Typically, renewable energy plants with zero fuel costs, such as wind, solar and hydro, are first in the merit order. Note: For the modelling, we do not consider hedging because regulations will affect them in the same way as the spot market, and the impact will merely be felt later.
- b. **Market situation:** To determine prices that generators receive from the spot market, we have modelled four country-specific market situations: one peak, one base, and two mid-load situations. These situations contain information regarding electricity demand and the specific availability of fluctuating renewables. This enables us to determine the price setting technology in each situation and corresponding margins for all other generation technologies.
- c. **Capacity markets:** Capacity markets are established to ensure that sufficient reliable generation capacity is available. Therefore, payments are provided to utility companies to

encourage investments in new generation capacities or for existing capacities not to be decommissioned.

d. **Balancing service:** Electricity generators with flexible ramp-up generation capacities receive money for providing electricity that ensures the short-term balancing of electricity supply and demand.

e. **Renewable subsidies:** To account for the fact that in many markets total technology costs for renewables are currently more expensive than for fossil-fuelled technologies in most markets, we have analysed the market situations of renewables for all countries in focus and have determined the height of subsidies necessary for renewables to be just competitive. In general, due to learning curves and economies of scale, subsidies decrease over time.

6. **Derive financial impacts on companies.** The relative position of all technologies (and companies - see point 4) is analysed in the light of market developments (see point 5). In the case of utilities modeling, this included technology-specific revenues from all possible revenue streams (see point 5, comments a-e) over time as well as technology-specific opex and depreciation.

Note: For an overview of how to develop scenario analysis and integrate this into company valuations and investment decision-making, please see the *Investor primer to transition risk analysis* published by Kepler Cheuvreux and The CO-Firm ([link](#)).

Limitation of method applied

Although the underlying method has been developed over years and reviewed by a range of stakeholders, it does have its limitations that need to be taken into account and tested for when incorporating results into financial modelling.

- **Scenarios are not associated with likelihoods:** The underlying scenarios are operationalised IEA scenarios (see the *Investor primer to transition risk analysis* report). Although this is inherent to scenario analysis and not a limitation per se, it is important to note. For instance, the IEA has been criticised for continuously underestimating the deployment of solar power in its scenarios. While it is fair to say that the scenarios try to anticipate drivers such as the falling costs of solar power, it does not estimate the likelihood of these drivers. The strength of the scenario is the plausibility and consistency of the outlined parameters over time.
- **Regulatory environment needs to adjust to ensure viability of expected technology mix:** The transformation of the energy systems will affect power system markets. In some countries, renewable capacity upgrades result in such low power market prices that additional income in the form of capacity payments is needed for fossil fuel operators to cover long-run production costs (also known as the “missing money problem”). Thus, the model endogenously calculates capacity payments to ensure consistency with the power generation mix outlined by the scenarios. Without capacity payments after 2025, conventional technologies have substantially lower earnings than outlined.
- **Subsidy development is linked to the profitability of renewables:** Changes in power market prices and capex (due to learning-curve effects) influence the earnings of renewable assets. Renewable subsidy developments are calculated for the long term endogenously by allowing renewable asset owners to allow for sufficient profit margins. With increasing earnings from power markets, renewable subsidies decrease or phase out. Individual countries’ actions might deviate from such a strategy.
- **Companies’ asset development assumptions:** The model assumes that companies will remain active in country-asset combinations they are invested in today, or are planned to be invested in by 2020. To make data for companies’ new investments until 2020 more reliable, we rely on S&P’s *World electric power plants database* (from June 2017) for research methodology and data of new projects. According to S&P, the key determinants in approximate order of importance for new company investments are: 1) order placement for generating equipment or EPC services; 2) the status of licensing or permitting activities; 3) funding; and 4) the availability of fuel and/or transmission access. Furthermore, as no market entry of new players is assumed, capacity upgrades outlined by scenario are shared among existing companies.
- **Scenario analysis and alignment assessments.** It is important to understand that the ACT/market EBIT (2° C) scenario tests for the

financial impact of the various parameters (e.g. carbon prices, electricity demand) compatible with such a trajectory, but it does not assume that the companies are “aligned” in terms of their asset base, as understood under the science-based target approach (and more specifically the sectoral decarbonisation approach) or SEI Metrics’ 2° C portfolio test (misalignment of activities based on future production by technology, and the technology portfolio requirements illustrated in the IEA’s scenarios).

In fact, while several of them can, the remaining fossil fuel plants are too large to be equally distributed to allow for a linear ownership across utilities companies. Thus, few companies will show higher emissions than aimed for, to ensure system stability. Also, note that alignment with science-based targets is not per se correlated with financial performance.

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